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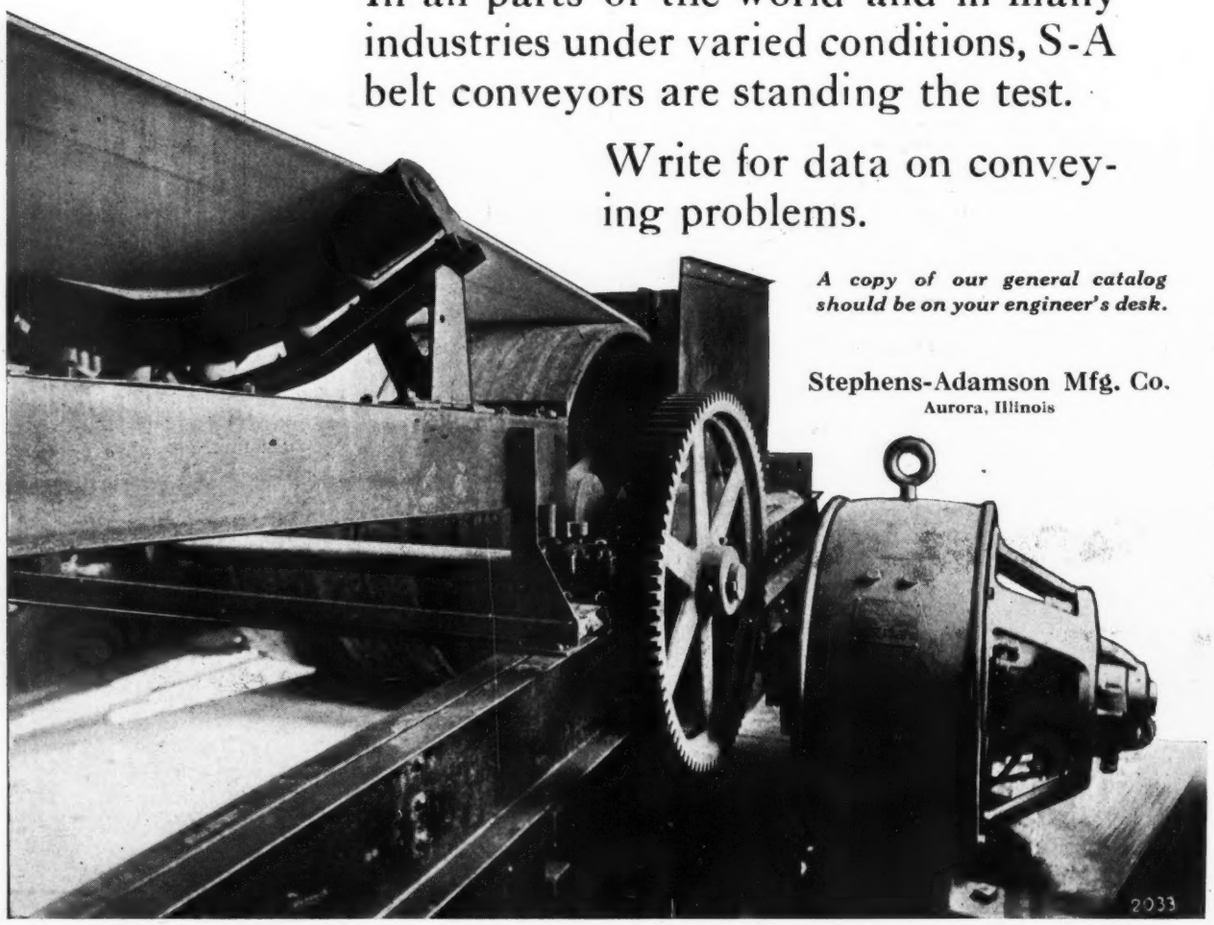

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METALS NON-METALS PETROLEUM

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The Grand Canyon Mystery

IN OUR ISSUE of Aug. 21, in the Court Decisions in Mining Cases Section, it is recorded that the Supreme Court of the United States has affirmed judgment in the case of the United States against Ralph H. Cameron and others, "enjoining the defendants from occupying, using for business purposes, asserting any right to, or interfering with the public use of, a tract of land in Arizona approximately 1,500 ft. long and 600 ft. wide which Cameron was claiming as a lode mining claim. The tract is on the southern rim of the Grand Canyon of Colorado, and embraces the head of the Bright Angel Trail." It was staked by Cameron in 1902. The report of our legal editor proceeds: "Cameron also had sought patents for other claims embracing other portions of the trail into the Canyon. On these claims Cameron applied for a patent, which would have given him undisputed rights to the surface of this permanently valuable tract. The Commissioner of the General Land Office held that the claims were not valuable for mining purposes, and therefore invalid." The matter was appealed to the Secretary of the Interior, who "reported that with the possible exception of the Magician lode claim the evidence wholly fails to show valuable desposits of gold, silver or copper, or other minerals."

The report of the Secretary fails to mention platinum, which is the principal mineral claimed to exist in these properties by those who staked and held them. These alleged enormous platinum deposits of the Grand Canyon have for years attracted attention and comment. We should like further elucidation of this mystery before the matter is dropped. Has the whole been a bold scheme to defraud the Government and the public by grabbing the Bright Angel Trail under pretense of mining locations? The opinions of the Land Office, the Interior Department and the Supreme Court would seem to so imply. If this is the case the Government should not rest with a simple denial of the property to the claimants, but should take steps to prosecute the fraud.

If fraud has been attempted it has been complex, and has not rested on a passive holding of the claims. Great pretensions to valuable platinum content have been repeatedly and forcibly made for years; and many capitalists have been solicited to interest themselves. At least one prominent mining geologist was retained by the owners, whose final opinion, we believe, was that the sandstone actually contains platinum. On the other hand, engineers and investors who have investigated or attempted to investigate these deposits have given various confidential accounts of their experiences, which clearly imply, in their opinion, the possibility of their samples having been salted with platinum in some mysterious manner, which one engineer opined might be with the ash of platinum prints used in local photography. One large user of platinum has stated that he found platinum in a sample of the ore submitted for assay; but on asking for a hundred pounds or so of the ore was unable to obtain it, and therefore dropped the matter. The assay certificate was, however, used to attempt to interest others.

The halo of romance has never left this fabulous platinum wealth on the brink of a marvelous canyon. Even with the platinum actually infesting the sandstone, it eluded profane and irreverent seekers. Therefore, a Philadelphia man invented a machine which would and did recover it (he said); whereas the crude and discredited fire assay did not recover it. Where have we heard something like that before?

Selective vs. Tonnage Mining

ONE of the most important developments of modern mining is tonnage mining or low-grade ore mining on a large scale. The Alaska Treadwell mine was an excellent example of this kind of mining. The "porphyry coppers" represent without much doubt the best development in this respect. The principle thus established has to a considerable extent influenced mining operations of lesser magnitude. As a consequence there was less and less discrimination in the selection of ore in stoping operations. A low unit cost for mining and milling extended stoping limits. Milling capacity was increased to enable large tonnages to be handled.

The changed economic and labor conditions during and since the war have pinched in on the mining industry to such an extent that profit margins have been greatly curtailed. This is true of both small and large operations, and particularly so with reference to gold mines. A modification of the tonnage system has been recognized, and wherever it is possible to change mining consistently to conform to the new order it is being done. Higher-grade ore is being mined. Stope limits are curtailed and ores are more carefully selected.

It costs just as much to mine and mill a ton of waste as a ton of ore. Reduction in the amount of waste mined is the order of the day. Hand picking of waste out of the ore stream was at one time practiced, but tonnage mining cut this out to a considerable degree; it is not practical to reintroduce it under existing labor costs and efficiencies except in a few cases, and in its absence the stope becomes the important factor.

Consistent and thorough underground sampling is essential, that discrimination between ore and waste be properly made. The net result will be to increase the unit cost of mining and to reduce the tonnage mined. Milling capacity must necessarily be curtailed either by operating on one shift or two shifts, instead of three, or by shutting down some of the units in

the mill. Overhead costs can under the circumstances be lessened, although not in proportion as capacity is reduced.

No one can foresee how long existing conditions are to last, but while they last the technical men in charge of mining operations are put to a greater test than ever before. That they have responded to the test is shown by the continuation of mining. It is true that there is, on the whole, some curtailment, but the intensive study and work required to maintain the industry will react beneficially in the long run. It has established the importance of good leadership and the wisdom of close technical control of mining operations.

The Reports of the "Porphyry Coppers"

THE reports of the "porphyry coppers" for the second quarter of 1920 were issued a few days ago, and are published elsewhere in this issue, all of which reflect the lamentable situation in the copper market. Not one of the four companies, Utah, Nevada Consolidated, Chino, or Ray Consolidated, was able to show a profit from copper production equivalent to the disbursement to stockholders. Including even the support of miscellaneous income, only one company, Chino, was able to show a profit greater than dividend disbursements. The following comparative table brings out this point:

PORPHYRY COPPERS SECOND QUARTER OF 1920

	Production in Pounds	Net Profit From Copper Production	Total Net Profit	Disbursements to Stockholders
Utah	29,004,381	$1,254,033	$2,240,470	$2,436,735
Nevada Cons	13,063,677	47,276	384,000	499,864
Chino	11,989,451	260,032	330,152	326,242
Ray Cons	12,965,596	343,651	387,255	394,294
FIRST QUARTER OF 1920				
Utah	27,257,546	$2,291,012	$2,870,590	$2,436,735
Nevada Cons	11,138,225	132,529	215,583	499,864
Chino	10,621,276	737,605	809,727	326,242
Ray Cons	11,650,443	587,166	637,300	394,294

During the first quarter of 1920 a better average record was made, although the record for this period failed to indicate the improvement desired. Production increased during the second quarter, but financial results —due entirely to the low selling price of copper—were comparatively poorer. Were it not for the substantial financial assistance rendered by miscellaneous income, through returns from byproduct precious-metal recovery, and railway dividends, the statements would have been worse, and surplus accounts would have been used to a greater extent. In the case of Nevada Consolidated, the miscellaneous income, chiefly a heavy credit from the Nevada Northern Ry., was about seven times as large as the operating profit.

In the matter of costs, all the porphyry companies with the exception of the one making the best general showing, Chino, were able to show a reduction in comparison with costs for the first quarter:

	—Net Cost per Pound— Second Quarter	First Quarter	Average Sales Price of Copper Second Quarter	First Quarter
Utah	11.77	11.94	18.21	21.99
Nevada Cons	15.56	20.72	18.50	22.66
Chino	15.29	13.91	18.17	21.88
Ray Cons	15.34	16.30	18.42	21.96

The reduction in costs may be attributed principally to the greater production for the second quarter. Chino's exceptional increase is accounted for by the lowering in the tenor and quality of the ore.

Considered collectively, the four porphyry copper companies are bearing up particularly well under the depressing influence in the industry, and are giving an exhibition of operating results which, although not satisfactory as expressed in dollars and cents, record splendid "staying" powers. These companies are essentially large-scale producers, a fact which has been held against them for times such as these, but considering the many adverse industrial and economic contingencies which they have had to surmount, their statements are of prime importance in illustrating what they can do with copper at a bottom price.

A possible further curtailment in dividend rate is likely with a continuation of the present conditions, but a relatively small and warranted increase in copper prices will greatly assist in lifting the "porphyries" out of their troubles.

Higher Freights May Be Temporarily Troublesome

LAST week we spoke of the freight rate increases, which we believe are fully justified in promoting railroad and, indirectly, industrial efficiency. The mining industry will be affected adversely, however, until the general improvement of conditions overtakes the temporary hardship which has been imposed. Precious-metal mines which are in a position to ship a finished product in the form of bullion will be affected only in so far as the cost of supplies, fuel, timber, steel, lubricants, and machinery are concerned. In the case of lead-silver mines shipping either first-class ore or concentrates there will be a considerable increase in cost for the movement between mine and smelter. Necessarily these mines will also have to meet increased freightage on their supplies.

With the copper mines there will be an increase in the cost of coal, fuel oil, and supplies, as well as increased cost for the shipment of copper bullion to tidewater. Already, with the decreased production, many copper mines will find the narrow margin upon which they are operating still further reduced. That there will be internal readjustments to meet such increases is obvious, and we may expect some copper mines to shut down.

Excepting lead and silver, metal prices have sagged or else have remained at low levels. There does not appear to be the possibility of passing on the increase, and for the time being the small producer as well as the large company will be compelled to strive for greater economy and higher labor efficiency.

The Search for a Meteorite

LEGEND has it that a vast store of Inca treasure lies at the bottom of some Peruvian lake, and on this basis many a tale of adventure has been written. The quest for hidden treasure, whether for rainbow gold or Ponzi's millions, is always alluring, and man is never wearied even though the work be fruitless. Today, the search is being renewed in Arizona for the great meteorite that is held responsible for the huge crater near Winslow. In its fascination this enterprise far surpasses any mere hunt for buried gold. One is reminded of the craters made by the projectiles in which the Martians in H. G. Wells' "War of the Worlds" invade the earth to conquer it, save that the Winslow crater is vastly larger. In diameter it is well over 4,000

ft., and the meteorite that caused it must have been of huge proportions, though it undoubtedly was much smaller than the crater itself.

Attempts to locate the meteorite have been made before. One company found its sinking operations, which were well within the crater, frustrated by quicksand which it could not handle. Today, a new organization known as the Crater Mining Co. is working on a different theory and is drilling with two Standard rigs on the chasm's inner edge. It is thought that the projectile from the heavens may have struck at an angle to the vertical, so that the mass does not lie directly below the crater's center but off to one side. Fragments of meteoric nickel have been found from time to time, supporting the theory of the meteorite's existence. The mass of metal that it is hoped to find is a prize worth searching for. But there is interest in the enterprise aside from that of possible financial return upon the investment.

This search for a meteorite is merely one of the many fascinations of the mining game, fascinations that generally hold the player even though the game yield an inadequate return. According to Emerson, everything has its just compensation, and the engineer may, and often must, accept the romance of the industry in part payment of what is due him.

Safeguarding Government Co-operation With Industry

THE Bureau of Standards has been during recent weeks establishing a number of so-called "industrial fellowships." The fellows so appointed are detailed to work at the Bureau by individual companies or associations on problems which are of common interest to the industry and the Bureau. By this means more intimate acquaintance with Bureau work will be gained by the industry, it is expected, and a considerable measure of support not previously available is given to the Government investigations.

The direct and rather obvious advantages of this co-operation should not, however, obscure certain possible disadvantages which may follow if each such project is not well considered and properly safeguarded. One of our Government bureaus, not, however, the Bureau of Standards, was recently referred to by a prominent engineer as being operated mainly "by and for appropriations." This tendency, indeed, is apparent from time to time in almost all of our bureaucratic activities, where there is a disposition to place expediency first in planning investigations, and effectiveness or appropriateness of work second.

Individual companies co-operating with any Government body are likely to stir up the suspicion, if not an actual public charge, of favoritism in the use of public funds. This is a charge easily made and difficult to refute at times, even when not justified. Another evil equally difficult to guard against is that of subordinating fundamental general investigations, which should be foremost in the program of the Government, to industrial studies of more specialized interest, which are for the moment more attractive, promising the individual investigator more immediate recognition.

It is to be hoped that none of these difficulties will be encountered by the Bureau of Standards in its new activities. We see no reason why these pitfalls may not be wholly avoided. Our industries, however, must co-operate to this end and avoid all appearances of leading any bureau into a false position by approching it with offers of co-operative investigation where special interest or commercial, rather than fundamental, problems are involved.

Deflation No Menace to the Mining Industry

THE long-expected and much-postponed decline in commodity prices seems at last to have set in in earnest. The textile industry appears to have borne the brunt of the first onslaught, the woolen, cotton and silk mills now being operated at considerably reduced capacities or having shut down entirely. Merchants are confronted with daily losses on their inventoried stocks, which induce them to turn to bargain sales in order to unload. Sugar, which advanced possibly more than any other commodity equally widely used, has dropped from 25 to 19c. retail. It is surprising how easy it is to secure it now compared with the difficulty several months ago when the market was advancing.

Although business interests cannot expect to prosper in the next two or three years as they have in the term just passed, we can see no reason for alarm in the mining industry. Rather the contrary. Mining supplies and labor are almost certain to fall more than metal prices. The latter, with the exception of lead and iron, are too near the cost of production to be seriously affected. Iron is too badly needed for reconstruction purposes to experience any great dullness. Then, too, much construction work in which iron is used has been delayed during the last few years.

Lead may slump some, but, even with present high prices, production is too curtailed to allow much of a drop. Silver, of course, is pretty well pegged. Copper and zinc should be in greater demand month by month as normal conditions are restored. We think it unlikely that any great increase in price will take place in either of these metals, for general conditions do not favor such a change. Rather will these industries prosper through reduced costs of production.

So, although the big manufacturing industries may look on the period of deflation with some qualms, and the profiteers and speculators with actual dismay, the rest of us may profit. Things, as someone has said, affect different people differently. Adam, William Tell, and Isaac Newton each had his little affair with an apple, but with quite different results.

In Re "Coyote Howlings"

IN THE *Engineering and Mining Journal* of July 31, 1920, p. 228, in the news item on "Minerals Separation Hearings End at Salt Lake," our correspondent used the following sentence: "The term 'coyote howlings' is used to designate licensees making complaints." On investigation we find that the term was a facetious one used in certain correspondence between officials of Minerals Separation. It was not applied to licensees, but to attacks on Minerals Separation by certain sections of the technical press. It is an injustice to both the licensees and to Minerals Separation to permit the erroneous implication of the expression to remain unacknowledged, and we make correction.

WHAT OTHERS THINK

Pebble-Mill Grinding, and Amalgamation

I have read with a great deal of interest the article by Jesse Scobey on the operation of the La Luz & Los Angeles Mine, in Nicaragua, in your July 3 issue. There are some points which I hope Mr. Scobey will be able to explain to me, and in addition, from my long experience in amalgamation with stamps and Hardinge mills, I wish to comment upon the findings as expressed in Mr. Scobey's article, and may, in some small way, aid not only him but operators who have an amalgamation problem involving stamps and pebble mills.

From the summary of eleven years' amalgamation mill reports, it would appear that the Huntington mills were the best amalgamators; following them the stamps were the best, and last of all the stamps and regrinding pebble mills. I presume that the efficiency in amalgamation of the Huntington mills was due to the original character of the ore rather than to the efficiency of these machines as amalgamators. As described by Mr. Scobey, the ore which the Huntington mills treated carried the gold in a form very easy for amalgamation. What I am interested in is whether the results shown for 1919, using stamps only, with an extraction of 69 per cent, can be directly compared to the results for 1918, when the ten stamps, one ball mill and two pebble mills were used. If the ore treated in both years was the same, then stamps are the better amalgamators. This is contrary to my experience, particularly in work on ore from the Plymouth Consolidated Gold Mines, Ltd., Plymouth, Cal.

The original test work on the Plymouth Consolidated was carried out in a small two-stamp battery and showed a 69 per cent extraction by amalgamation. The equipment, as finally installed, consisted of thirty stamps grinding to 2 or 4 mesh, followed by Hardinge pebble mills regrinding in open circuit, as was used at the La Luz & Los Angeles. After their preliminary difficulties had been overcome the first eighteen months showed an average extraction by amalgamation of 71 per cent, the highest being 75 per cent and the low 55 per cent. These variations were due to the variations in the character of the ore. I have always explained the higher amalgamation recovery in the final plant as being due to the polishing action of the pebble mill regrinding, which put the gold in better condition for amalgamation than when broken loose from the gangue by the cracking action of the stamps.

The low recovery with the stamps, ball mill, and two pebble mills at La Luz & Los Angeles may be due to failure to use sufficient amalgamating devices. I have found that one cannot use too many such, particularly where tube or ball mills are used to regrind after stamps. At the Plymouth Consolidated Gold Mines, Ltd., the Hardinge patent amalgamators are used on the discharge of the pebble mills, followed by riffles similar to those employed in placer mining, then lip plates, then amalgam traps, then finally the stationary plates as used in most amalgamation practice. A similar method of amalgamation is practiced by the Gold Hill & Iowa Mines Co., Quartzburg, Idaho, and the Carson Hill Gold Mining Co., Melones, Cal. The chief reason for the Hardinge amalgamator on the discharge end of the mill, as well as the riffles, lip plates and traps, is that it has been found that when the gold is released by the rubbing action of the regrinding mill it is in ideal condition for amalgamation. It is also in ideal condition for coating, particularly if there is a considerable quantity of iron sulphide in the ore. If the gold is taken from the discharge of the pebble mill to the stationary plates through launders from 12 to 16 ft. long it has been found that amalgamation recovery on the plates is not as good.

At one property on the Mother Lode in which I was interested free gold was found in the concentrates on the tables where the discharge from the mill was sent to the stationary plates through distributing launders about 16 ft. long. Upon the addition of lip plates and amalgam traps immediately following the discharge of the mill this fine free gold in the concentrates disappeared and the extraction by amalgamation was materially increased. It may be wise to describe briefly here the lip plate used. For a 100-ton plant the lip plate is usually about 4-ft. wide by 6-ft. long, silver plated with 4 oz. of silver to the square foot and set at a slope of 2½ in. to the foot. This plate is only dressed every two days to a week, depending upon the richness of the ore, and the attempt is made to keep the amalgam thick and pasty. The amalgam traps are usually simple devices where the pulp flows in and is agitated by water under pressure, either ascending or descending, and flows out the other side of the trap after coming into intimate contact with a bath of quicksilver in the bottom of the trap.

Another point I have found which amalgamators overlook is that the treatment of the stationary plates after regrinding in a mill is considerably different from the treatment usually practiced after reducing in stamps. In mills using regrinding the best practice appears to be to dress the plates every morning, putting on only enough quicksilver so that when rubbed up it will be soft enough to roll up under the finger. Quicksilver is usually rubbed in with a burlap cloth or any rough piece of cloth, then brushed with a soft whiskbroom. This seems to be the best practice for the stationary plates, and keeps them in the best condition for amalgamating after regrinding mills. The Hardinge amalgamator is a rather simple device bolting onto the discharge end of the mill in place of the discharge bell, and was devised particularly for the Plymouth ores, in which there were considerable arsenical pyrites, so as to amalgamate as close to the grinding medium as possible but without actually feeding quicksilver into the grinding medium. However, on an ore containing no arsenical pyrites and showing no tendency for the quicksilver to flour and be lost, such as at the plant of the Gold Hill & Iowa Mines Co., quicksilver is fed directly into the feed of the pebble mill and the amalgamator is used purely as an accessory amalgamation device.

Mr. Scobey states that the test between the ball mill and the stamps could not be continued because of the lack of comparative data, and that both were retained. It is regrettable that actual data were not taken on the comparative work of the stamps and the ball mills as metallurgical devices, as well as mechanical devices, for the reduction of ore. The theory has been advanced, and seems to be well authenticated, that with small smooth balls in the mill the gold in the ore is beaten into cup shapes, which flow over the plates, through the amalgamating devices, and finally are only caught on the concentrating tables. This theory has been advanced to me by those in charge at the Gold Hill & Iowa Mines Co. In their particular case, as in that at the La Luz & Los Angeles, the ball mill which was installed had to be relegated to the place of a mechanical reducer, and the discharge from the mill was sent to the pebble mill and to the amalgamating devices. E. E. Carter, general manager of this company, told me that when an attempt was made to amalgamate after the ball mill the millmen could not make the proper amalgamation recovery and that they had to put the ball mill back to a primary reducer, sending the pulp produced by it through the pebble mill, before extraction by amalgamation became normal. I should like to hear from Mr. Scobey on this point as well as from any other readers of the *Engineering and Mining Journal* who have had a similar or a different experience in this kind of work.

Mr. Scobey also says that one of the pebble mills was operated in open circuit, "although not orthodox." I wish to state that in all of the plants mentioned above, where I have closely studied amalgamation after ball mills, and particularly the operation of pebble mills regrinding after stamps, none of these mills have been actually close-circuited with a classifier. In fact, it was found that at the plant of the Original Amador Consolidated Mining Co., Amador City, Cal., when the regrinding mills were close-circuited with a classifier, the gold was trapped in the circuit and ground so fine that amalgamation results were very poor, and this fine free gold was caught only in the cyanide plant. A change to mills in open circuit gave much better results. As the La Luz & Los Angeles had a mill in open circuit, followed by amalgamation, and also a mill in closed circuit, it might be interesting, if possible, to determine which gave the better amalgamation results. The usual practice has been to send the mill product, diluted as Mr. Scobey states in his article, over the plates, the tailings from the plates being elevated to the classifier, making as a rule three products. The first spigot discharge is an oversize, which is sent back to the mill for regrinding. The second and third spigot discharges are sent to sand tables, and the overflow from the classifier is thickened for concentration on vanners or other types of slime concentrators.

Hard ore from the mine is being used for regrinding mediums, according to Mr. Scobey. I should like to know if he has any data indicating whether the change from Danish flint pebbles to mine rock had any effect upon the capacity of the mill. I have found, as a rule, that it does have an effect upon the capacity, because energy is wasted in rounding off the chunks of ore before they become efficient as grinding mediums. I found, however, that one way to overcome this loss of efficiency in grinding is to speed the mill up several revolutions, thereby increasing the action in the mill and rounding off the chunks of ore just that much sooner. In the case of the Utah Leasing Co., Newhouse, Utah, where the change was made from Danish flint pebbles to a local quartzite, material economies were at once apparent in the cost of grinding, but the mills had to be run considerably faster than ordinarily. These mills were 8-ft. x 48-in. Hardinge pebble mills, and, with an El Oro type of lining, were operating at 28½ revolutions. Ordinarily the practice would have been to operate them at about 26 revolutions. However, the change to mine rock had no material effect upon the capacity of these mills, owing, in my opinion, mainly to the high speed at which the mills were operating.

I have one last point to comment upon in Mr. Scobey's article. He states that with the pebble mill running in open circuit, delivering a finished product, the practice developed of making a very wet discharge direct to the plates: "An excess of water permitted a classification in the mill that held back the oversize." This is a point very little recognized in the operation of a Hardinge mill, and something about which every operator of this machine should know. However, instead of making the feed to the mill dilute, the better practice is to insert a water pipe at the discharge end of the mill. This pipe is usually ¾-in. pipe with a ½-in. nozzle, and it is led into the discharge trunnion of the mill on the lifting side. The spray from the nozzle is then directed at an angle so as to hit as near as possible the point in the mill where the pulp and pebbles are cascading. The flow of water is regulated so that the pulp will not get beyond 18 in. to 2 ft. from the discharge end of the mill and therefore does not dilute the portion of the mill where the most grinding is being done. With this device the pulp in the feed to the mill is kept thick and the discharge is diluted so as to release the oversize particles, allowing only the finer material to discharge. The installation of such a device at the Bluestone Mining & Smelting Co., Mason, Nev., increased the capacity of the mill almost 10 per cent and had no effect whatever upon the consumption of grinding mediums, because the pulp in the effective grinding portion of the mill was still kept at from 75 to 80 per cent solids by weight.

V. A. STOUT.

New York, N. Y.

Suggests a Gold Producers' Bank

The position of the gold producers today suggests to my mind that there is something fundamentally wrong that they should consider. Briefly, under the gold standard gold establishes the basis for money credit, but the producers of gold do not get the credit. The producer turns in his gold for about $20 per oz. That same ounce of gold has a money credit, which the banking interests get.

The gold producers in my opinion can correct this situation, and come into their own, only by forming a "Gold Producers' Bank," where all production will be deposited. The banking or industrial interests can then obtain the gold by payment of the credit value for gold, or it may be possible for the Government to issue currency to such a "Gold Producers' Bank" upon the credit system in operation.

In any event the gold producers would get what belongs to them rightfully, and the credit they establish would be in their control.

I am advised that there is no law compelling gold producers to sell their production to the Government.

Reno, Nev. F. A. WRIGHT.

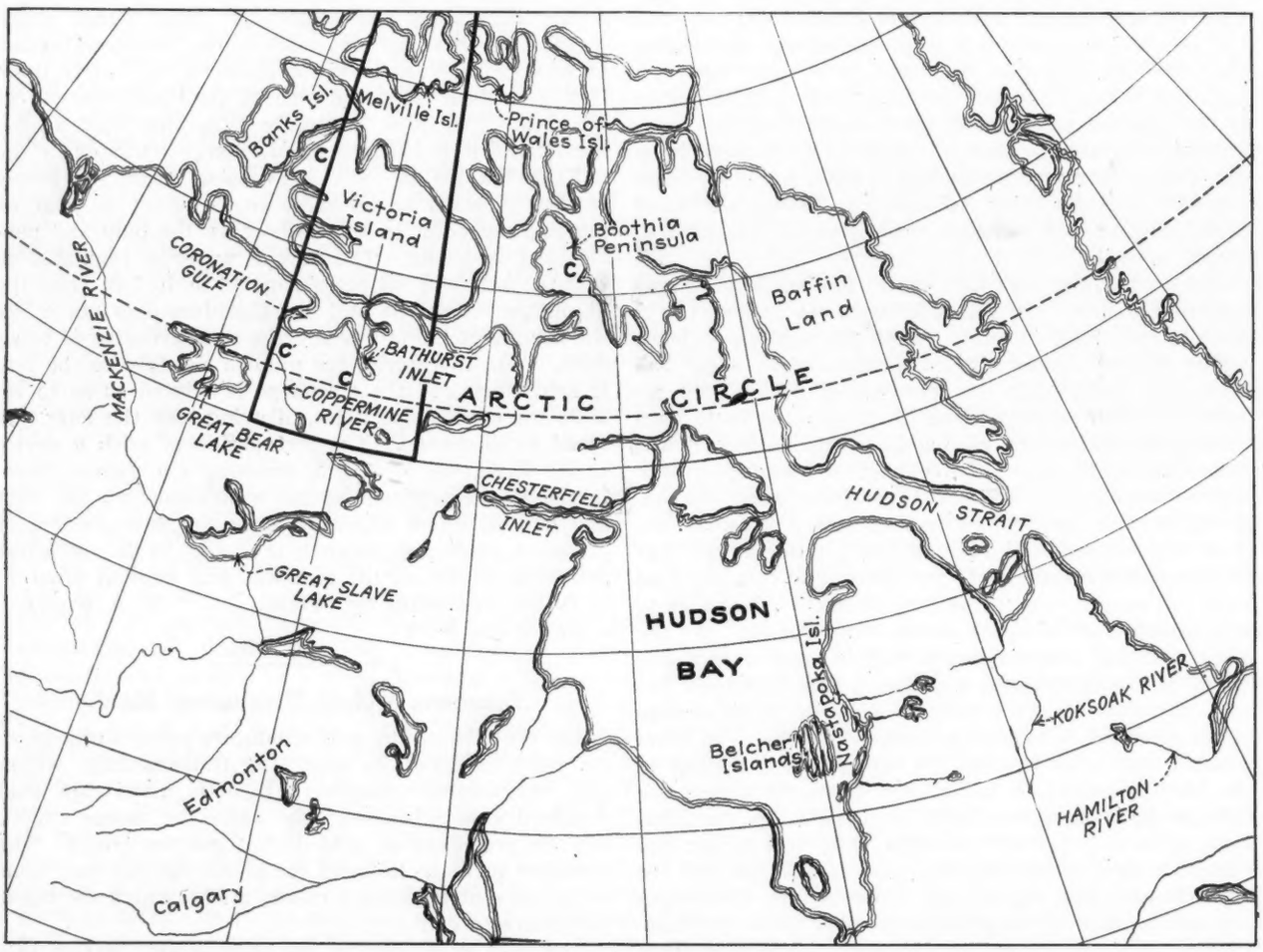
Ore Deposits of Arctic Canada

Occurrences of Iron and Copper Most Promising Discoveries Reported to Date—Latter Metal Widely Distributed—Gold Apparently Scarce, Though Pyrites Is Not Uncommon—Silver, Lead, and Zinc Ores and Other Minerals Found in Minor Quantity

By E. S. Moore
Written exclusively for *Engineering and Mining Journal*

With the extension of the railroads northward into the previously little known regions of northern Canada, interest in the possibility of finding ore deposits in Arctic Canada is daily increasing. The airplane has developed such efficiency as a new means of exploration that many mining men look forward to the time when rapid excursions may be made into the areas hitherto beyond the reach of all except a few adventurous souls who were willing to make long and perilous expeditions.

Through the explorations of Low, Bell, Tyrrell, Stefansson, O'Neill and many others the world has learned a little of the possibilities of that tremendous area which should surely harbor somewhere another Keweenaw Point, another Sudbury, Cobalt, or Mesabi. It has been known for some time that the rocks in the north-central part of the continent are chiefly pre-Cambrian and that they possess many characteristics similar to those of the great ore-bearing regions farther south. The Upper Huronian iron formations have been found underlying considerable areas in a number of localities, and the Keweenawan rocks, the parents of the Michigan copper, the Sudbury nickel, and the Cobalt silver deposits, are spread over a great expanse from the southern end of Hudson Bay northeastward to the Atlantic and northward and northwestward to the Arctic. During the Keweenawan period a great curved, volcanic zone extended from the Lake Superior basin through the Sudbury and Cobalt fields, along the Hudson Bay basin to the Arctic, and in this disturbed zone extensive igneous activity manifested itself. The time during which this occurred was one of the most notable metallogenetic epochs in the earth's history.



MAP OF NORTHERN CANADA, SHOWING DISTRIBUTION OF ORE DEPOSITS IN ARCTIC REGION. "C" INDICATES COPPER. HEAVY LINE INDICATES AREA WITHDRAWN FROM STAKING.

In a description of the ore deposits of Arctic Canada it seems wise to include a discussion of some areas not strictly in the Arctic regions. These areas are so far north that the problems connected with their exploitation are much the same as those of the Arctic regions.

These areas are interesting chiefly because of their iron deposits, and this metal has not been reported in large amounts from within the Arctic Circle.

The metals which so far have attracted much attention in the Far North are iron and copper, but gold, silver, lead, and zinc have all been found, and among the non-metallic minerals mica and graphite are reported in commercial quantities. It has long been known that coal exists in considerable quantities north of the Circle. The accompanying map indicates the distribution of the main areas of copper lands discovered up to the present time.

Most Interesting Iron Areas in Labrador and on Islands in Hudson Bay

A number of areas of the Huronian iron formation have been mentioned in geological reports under the head of Cambrian or other systems. Those which have been of most interest are the Nastapoka and Belcher Islands, in Hudson Bay, and the Koksoak River area, in the Labrador Peninsula near Hudson Strait.

LEFT, TYPICAL SCENE IN LABRADOR WHERE COUNTRY IS ALMOST TREELESS. RIGHT, AUTHOR'S CAMP NEAR MOUTH OF GREAT WHALE RIVER, HUDSON BAY

According to Low[1], the Nastapoka Islands form a group about 120 miles long made up of sixty-five islands situated along the east coast of Hudson Bay. They rise to a maximum altitude of 500 ft. and are separated from the mainland by Nastapoka Sound, one to three miles wide and deep enough for the navigation of the largest ships. They consist chiefly of sedimentary rocks, which include iron formation, shale, sandstone, and dolomite and which appear to be Upper Huronian in age.

The iron formation is similar to that found in the Lake Superior region, and consists of banded jasper, hematite, magnetite, and cherty iron carbonate. The formation is exposed on practically all the islands, but the bands of ore in the jasper are thin. No analyses are given by Low, but his descriptions indicate that as a whole the ore is very siliceous and of low grade. The thickest band of good ore mentioned is 4 ft. thick, and this band outcrops on Clarke and Gillies islands. All the sections indicate that, although there are numerous bands of ore, they are distributed through too much jasper to make them of much economic importance. The occurrence of these extensive areas of iron formation with bands of ore does, however, justify thorough prospecting for larger concentrations.

The Belcher Islands have been known locally for a long time, but it was not until 1914 that they were brought to the attention of people outside of Hudson Bay by R. J. Flaherty. In search of mineral deposits for the Northlands Exploration Co., Mr. Flaherty heard of the iron on these islands and visited them in the fall of that year. During the following year he studied this group and prepared a reconnaissance map of the islands. In the summer of 1916, I prepared a report on the iron deposits for Sir William Mackenzie, president of the Northlands company, and found considerable areas of iron formation. The results of this investigation have been previously published in the *Journal of Geology*[2] and the *Transactions* of the Canadian Mining Institute[3]. In making this trip some of the difficulties to be met in navigating Hudson and James bays were experienced. While in the midst of James Bay on July 1, 1916, our small steamer was surrounded by drifting ice, which continued to fill the bay for about five days. The ice snapped the propeller from the ship, and it was only after considerable difficulty that repairs were made. A new propeller was fitted on by dragging the stern of the ship up on the shore of a small island near by at high tide and adjusting it at low tide. The weather was stormy during much of the time, and it was only after many difficulties and numerous vexatious delays that the islands were reached and that the return journey was accomplished.

The Belcher group has usually been indicated on maps as small dots in the southeastern portion of Hudson Bay, but the main islands are of large size, the length being estimated at about ninety miles. One island has a lake within its borders about forty miles in length, according to Mr. Flaherty.

The rocks on these islands are Huronian and Keweenawan. The Huronian series contains sandstone, quartzite, limestone, dolomite, graywacke, shale, and iron formation. One of the peculiar features of the limestone is the presence of thick beds of concretions formed by the low and primitive plants known as algæ. The largest of these concretions, which are made up of concentric spheres, are about 15 in. in diameter and the smallest are the little oölites which in some places are replaced by iron oxide, iron carbonate, or iron silicate. It appears that these primitive plants and the closely related iron bacteria have had an important influence in the precipitation of the iron compounds from solution

[1]A. P. Low, "Report on the Geology and Physical Character of the Nastapoka Islands, Hudson Bay"; Geological Survey of Canada, Vol. XIII, Pt. D.D., 1903.

[2]E. S. Moore, "The Iron Formation on the Belcher Islands, Hudson Bay with Special Reference to Its Origin and Its Associated Algal Limestones"; *Jour. of Geol.*, Vol. 26, p. 412, 1918.

[3]"Iron Deposits on the Belcher Islands, Hudson Bay"; *Trans.* Canadian Min. Inst., Vol. 22, p. 100, 1919.

and the formation of the little granules of iron silicate and iron oxide which are similar to those found in the Mesabi Range of Minnesota.

The sediments on these islands are a continuation of those on the Nastapoka Islands, having been brought above the sea level in this region by folding. They are interbedded with sills of diabase and overlain by flows of basalt of Keweenawan age, the conditions resembling those found around the northern shore of Lake Superior. The islands are treeless, and in many places the rocks are perfectly bare of soil and vegetation, so the strata are as open to observation as the pages of a book. The great bands of jasper and red shale scoured off by the glacier make a very striking appearance, and naturally quicken the pulse of any prospector. The maximum thickness of the iron formation is about 275 ft., but the great bulk of the formation is hard, highly siliceous jasper with bands of slate or graywacke, the whole averaging less than 30 per cent iron. One band 35 ft. thick, measured in the best portion of the formation and carefully sampled, averaged 30.1 per cent iron, with 37.97 per cent silica, 0.039 per cent phosphorus, and a trace of sulphur. There are considerable bodies of this low-grade material close to tidewater. The highest-grade sample taken and analyzed ran 50.7 per cent iron.

The structure of the rock formations is comparatively simple, the dips running from almost nothing to 75 deg., and there is little faulting. There are frequent alternations of igneous instrusions or flows and sedimentary rocks. The iron formation lies immediately underneath a great flow of ellipsoidal basalt, which has spread practically all over the islands.

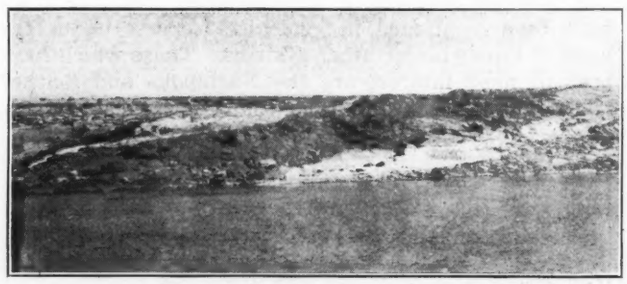
There has been much discussion as to whether the iron deposits on the Belchers are of economic value. It is my opinion that they are so lean, and the climatic

ALGAL CONCRETIONS IN LIMESTONE ON BELCHER ISLANDS

conditions are so unfavorable, that they cannot be worked at present. Electric smelting with power developed at the falls on the numerous rivers entering the east coast of Hudson Bay might be employed, but even then the conditions do not seem promising. The experiences which I had with the ice in James Bay early in July, in a year when everyone in that part of the country said the ice had broken early, convinced me that only specially constructed ships are safe in those waters. It is probable that as a rule the islands cannot be approached much before July 10, and in some seasons ice is said to remain around the islands until some time in August. Specially constructed ships might safely count on an open season from early July until the latter part of November in normal seasons, but they always run the risk of encountering heavy ice in Hudson Straits during that period. Eskimo labor may be employed for some purposes, but it cannot be relied upon for extensive mining operations.

Koksoak River Area Merits Further Prospecting

On the lower stretches of the Koksoak River, which empties into the head of Ungava Bay, Low[4] has found an extensive area of iron formation, and, although he states that much of the ore is low grade, he speaks of hundreds of millions of tons of ore and an almost inexhaustible supply of high-grade ore. He quotes a number of analyses which show that the metallic iron runs from 19.14 per cent in the lean jasper and garnet-



DOLOMITE MASS, IMPREGNATED WITH CHALCOPYRITE, ENCLOSED IN DIABASE SILL, BELCHER ISLANDS

iferous shale to 54.35 per cent in the better ore. The thickness of iron formation exposed is in some places over 400 ft. The rocks are described as Cambrian in age, but from all descriptions they appear to be the same as those around Hudson Bay, which are almost certainly Huronian.

From Mr. Low's description of this region and other areas one cannot but feel that he was a little sanguine regarding the quantities of high-grade ore seen. Nevertheless, there is no doubt that these areas merit much more extensive and detailed prospecting than Mr. Low was able to give them in his hurried reconnaissance expeditions through that hitherto unexplored country. The main outcrops of the iron formation mentioned occur in the vicinity of Shale Chute, Cambrian Lake, and the mouth of Swampybay River, on the Koksoak River. The locations are such that it should be possible to construct a railroad to the coast without great difficulty.

Scattered areas of iron formation carrying hematite and magnetite ore, but for the most part consisting of lean jasper, have also been reported by Low on the upper portions of the Hamilton River in Labrador. For example, at the narrows into Lake Petitsikapan, a band 20 ft. wide analysed 30.43 per cent iron. On Astray Lake and in a number of other places there are areas which may offer opportunities to prospectors in the future.

Copper Widely Distributed in Arctic Canada

Since the early days of exploration in and around Hudson Bay and on the Arctic islands great interest has attached to the occurrence of native copper in Arctic Canada. The Eskimos, like the primitive inhabitants of Michigan, have long made use of this metal for tools and for other purposes. They have been known to make pilgrimages to the sources of the metal, and many

[4]A. P. Low: "Report on Explorations in the Labrador Peninsula"; Geol. Surv. of Canada, Annual Report, Vol. 8, Rept. L.

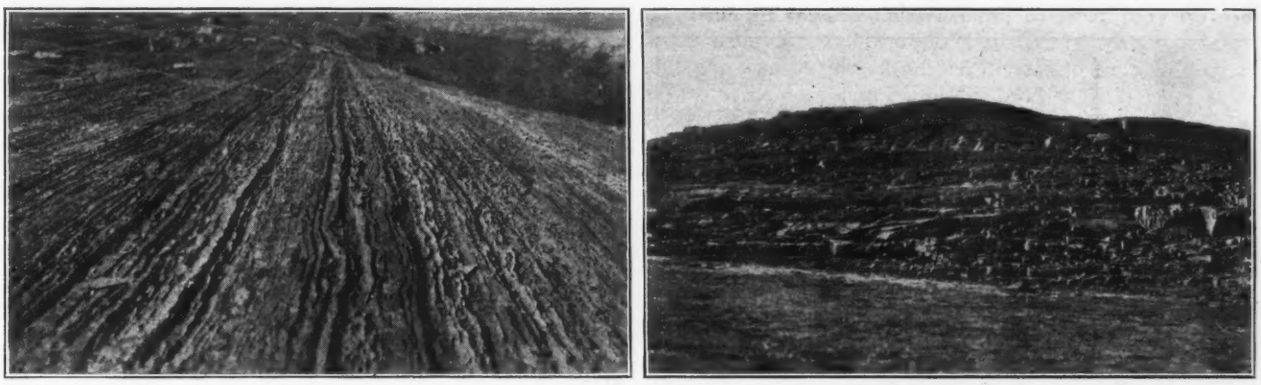
attempts have been made by white men, since that of Samuel Hearne in 1771 until the present day, to locate the mother lode. For a summary of the accounts of these expeditions the reader is referred to the articles by Tyrrell,[5] Douglas[6] and O'Neill[7].

There are certain conclusions on which most of the explorers agree. These are: (1) Native copper occurs widely distributed over the mainland and on some of the Arctic islands, and a few pieces of considerable size have been found; (2) the rocks are Keweenawan in age, and in nearly all respects closely resemble those of the copper-bearing area of the Lake Superior basin; (3) few of the areas so far examined contain extensive bodies of pay ore; (4) the probabilities of finding pay ore on a large scale seem promising; (5) great difficulty is experienced in carrying on explorations because of the remoteness of the area and the severe climatic conditions.

The areas in which native copper has so far been found by white men are on the Coppermine River, on vary from a few inches to several feet. The amygdules also carry chlorite, epidote, prehnite, opal, and agate. In some places the veins are important and carry several per cent of copper. Copper is found on practically all the islands and on the mainland in the vicinity of Bathurst Inlet.

In the Coppermine River area, the Copper Mountains are cut by the river about forty miles from its mouth and form a ridge about sixteen miles wide by forty miles or more long. They consist of interbedded basalt flows and sediments such as conglomerates and sandstones. According to Douglas[9], these rocks assayed in copper as follows: Conglomerates, 0.016-0.09 per cent; sandstone, 0.002; amygdaloid, 0.008-7.77; float, 0.09-43.39. There are traces of chalcocite with the native copper in some places. The most favorable locality mentioned is one on Burnt Creek.

From all descriptions of the copper-bearing rocks of Arctic Canada, a remarkable similarity is seen between the rocks and their copper deposits and the rocks of



LEFT, A GLACIATED SURFACE ON VERY LEAN IRON FORMATION, SHOWING EFFECT OF DIFFERENTIAL WEATHERING. RIGHT, IRON FORMATION OVERLAIN BY BASALT FLOW, BELCHER ISLANDS

Bathurst Inlet and on Boothia Peninsula. According to Stefansson and the members of the Canadian Arctic Expedition, the Eskimos also report deposits at the head of Prince Albert Sound, on Victoria Island. Two other places which have been mentioned are on the shores of Prince of Wales Island and on the Princess Royal Islands. The accompanying map shows the general distribution of these deposits and also the area which was withdrawn from staking for minerals by the Canadian government in 1918. This area lies north of 65 deg. N. latitude and between 105 deg. and 106 deg. W. longitude.

Bathurst Inlet and Coppermine River Deposits Not Directly Connected

According to O'Neill[8], the deposits on Bathurst Inlet are not directly connected with those on the Coppermine River, as formerly supposed. He describes the series as consisting of flows of basic rock with thin beds of sediments and with specks of copper distributed through the ground-mass of the basalt as well as in the amygdules. Copper also occurs as fissure filling. The disseminated copper runs about 0.25 per cent and the amygdaloidal copper will reach several per cent in some localities. The thickness of the amygdaloidal zone will the Lake Superior basin, and one cannot but marvel at the tremendous amount of metal associated with the basic rocks of the Keweenawan system. Probably in no period of igneous activity in the earth's history has there been a more definite connection between a series of rocks and a particular type of metalliferous deposit. In some cases the zeolites of the Lake Superior region are lacking in the deposits of the Arctic, but they are reported from other areas.

As to climatic conditions, O'Neill claims that the temperature seldom gets lower than 40 deg. F. below zero and that the snowfall is not heavy. There is lignite and bituminous coal on Great Bear Lake and on some of the Arctic Islands. At present, the field is reached by sailing around the north coast of Alaska or by way of Great Bear Lake, and the navigating conditions are extremely difficult. The obstacles in the way of constructing a railroad through the country are not insurmountable, and an abundance of water power is available. From his experiences, Mr. O'Neill seems to be of the opinion that mining operations on a large scale are quite within the bounds of possibility in this region.

Copper sulphide deposits have been found in a number of places. Probably the most important is that mentioned by O'Neill[10] in the southern and western portions of Bathurst Inlet. Here bornite (Cu_2FeS_3) replaces dolomite which immediately underlies the

[5]J. B. Tyrrell: "The Coppermine Country"; *Trans.* Canadian Min. Inst. Vol. 15, p. 508, 1912.
[6]James Douglas: "The Copper-Bearing Traps of the Coppermine River"; *ibid.* Vol. 16, p. 83, 1913.
[7]J. J. O'Neill: "Deposits of Native Copper in Arctic Canada"; *ibid,* Vol. 22, p. 406, 1919.
[8]J. J. O'Neill. *Op. Cit.*, p. 410.
[9]James Douglas. *Op. Cit.*, p. 101.
[10]J. J. O'Neill. *Op. Cit.*, p. 411-12.

copper-bearing basalts. One layer is mentioned which is 6 in. thick and assayed 49.87 per cent copper. Another analysis of diabase from a sill showed 1.18 per cent copper in disseminated chalcopyrite ($CuFeS_2$).

On the Belcher Islands, in Hudson Bay, I have seen small masses of chalcopyrite in the dolomite at the contact with diabase sills. A. P. Low[11] mentions the occurrence of several large bands of pyrite, pyrrhotite, and chalcopyrite on the shores of the bay into which the Kogaluk River flows. This bay lies about forty-two miles north of Portland Promontory, Hudson Bay. These are probably the only copper sulphide deposits reported so far that might be of interest to prospectors.

In writing of his explorations in the Labrador Peninsula, Low mentions deposits of pyrites in a number of places. They usually occur in the Huronian schists near the contact with granite. In addition to the deposit mentioned, there are quartz veins charged with pyrites and galena near the mouth of the Stillwater River on the Koksoak River. Half a mile above the mouth of Wabaminsk River, in the eastern portion of the peninsula, a deposit of pure pyrites 100 ft. long by 10 ft. thick is mentioned as occurring in green chloritic schists.

STEAMER SURROUNDED BY ICE, JAMES BAY, JULY 1, 1916

The Paint Hills on the east coast of James Bay are described as consisting of squeezed trap carrying large segregation masses of pyrites, which contain a small amount of silver but no gold. On one of his expeditions Tyrrell[12] found a mass of dark green Huronian schist cut by a highly altered diabase dike 75 ft. wide and containing a large amount of arsenical pyrites. This occurs north of Rabbit Island, on the shore of Hudson Bay.

Very little gold has been found in these northern regions, but it seems probable that with more detailed work the extensive deposits of pyrites will be found to yield this metal. Silver has been found in small amounts in several places. It occurs in the pyrites of the Paint Hills, as before mentioned, and in the galena which is associated with zinc near Little Whale River, on the shore of Hudson Bay. Assays of from 5.1 to 12.03 oz. silver have been reported by Low from this galena.

The lead and zinc ore occurs in a band about twenty-two miles long between Little Whale River and Richmond Gulf, and has been prospected to some extent but without marked success. The ore occurs in limestone or dolomite in this locality, as it does in a number of other areas where these Upper Huronian rocks outcrop.

In a small calcite vein on the Belcher Islands I have seen smaltite and cobalt bloom near a diabase sill. This is interesting chiefly because of its similarity to the occurrence of these minerals at Cobalt, Ont. According to reports, mica has been mined for a number of years by the Scotch whalers on the coast of Hudson Straits, and deposits of graphite have also been mentioned.

From the widespread occurrence of ores and the still more extensive distribution of rock series long notable for their metals, the chances of discoveries of extensive ore deposits in Arctic Canada and adjacent lands seem bright. The very severe glacial scouring which most of that country has undergone has no doubt injured some of the less resistant and more exposed iron deposits. The present climatic conditions are very severe, and they make traveling and mining operations difficult, but detailed prospecting should bring to light some very valuable deposit in that tremendous area, which will make it worth while to overcome climatic obstacles by modern engineering methods.

[11]A. P. Low: "Report on an Exploration of the East Coast of Hudson Bay"; Ann. Rept. Canadian Geological Survey, Vol. XIII, Pt. D, p. 28.

[12]J. B. Tyrrell: "Report on Doobaunt, Kazar and Ferguson rivers and the Northwest Coast of Hudson Bay"; Annual Report, Canadian Geological Survey, Vol. IX., Pt. F, 1896, p. 82.

Mining in Bolivia Hampered by Poor Transportation

The Department of Chuquisaca does not rank with Oruro and Potosi departments as among the important mining regions of Bolivia, according to the U. S. Department of Commerce. The working of such mineral deposits as do exist has been prevented by almost insuperable difficulties of transportation. During 1918 concessions for mining lands covering every class of mineral, from salt to radium, were presented to the departmental government, yet in reality little mining of any kind is carried on, although there is good evidence of existence of copper, silver, lead, and iron ores in the country to the east of Sucre. The presence of copper deposits in the Tarabuco district, about twelve leagues from Sucre, offers probably the best possibility for mineral development. The natives in the country about Lagunillas carry on some alluvial gold mining, and the fact that quantities of precious stones exist in the Tarabuco district is strongly insisted upon in Sucre.

Lake Tahoe Has Shrunken

Lake Tahoe, in California, is often said to occupy an old volcanic crater. This is not a fact. It is true that the region about the lake shows evidence of volcanic activity of various kinds and that the water has at times probably been dammed by outpourings of lava, but the lake itself lies in a structural depression—a dropped block of the earth's crust.

The prehistoric Lake Tahoe was larger and deeper than the present lake, according to the U. S. Geological Survey. During the Neocene epoch and the earlier part of the Pleistocene epoch its water stood much higher than now, but in its overflow it has since cut through the lava dams that maintained it at that height. Distinct beaches that mark the former higher levels of the lake stand about 100 ft. above its present surface, but the water doubtless once stood at even greater heights. At Tahoe City the most distinct of these old beaches is a terrace that stands 35 to 40 ft. above the level of the lake.

Physiological Effect of High Temperatures and High Humidities in Metal Mines*

A Preliminary Study of the Results of Atmospheric Conditions Underground—The Observations Show the Importance of Low Humidity and Rapid Circulation of Air in Hot Working Places

BY R. R. SAYERS[1] AND D. HARRINGTON[2]

ONE of the important problems encountered in present-day metal mining practice is that of providing efficient ventilation, especially in those mines which have high air temperatures and high relative humidities in extensive workings at considerable depths, or in workings where mine fires are found or where there is much oxidation of timber or of ore.

It has long been recognized that mine workers subjected to hot, humid, stagnant air, and to certain harmful dusts in many of our metal mines, contract miners' consumption and possibly other diseases; and though considerable study has been made as to dusts, as well as of temperatures and humidities, in mines in England,[3] South Africa, and of some European countries,[4] little has been done in the United States, especiallly in respect to the effect of high temperatures and high relative humidity.

The following study was made in two comparatively deep copper mines, both with fairly high temperatures and humidities, one in which there was practically no attempt at ventilation and one with a ventilation system of a much more efficient kind than is generally found in metal mines. In both mines, the data were taken at points over 2,000 ft. below the surface and with surrounding rock temperatures generally in excess of 90 deg. F.

In general, the following data were obtained: Surface air temperatures and relative humidities and body temperatures, blood pressure readings, pulse, and time of day. Underground data at each place visited included temperature and humidity readings of air in working places, occasionally rock and water temperatures, temperature of compressed-air blowers, air movement or velocity, kind of work performed, number of workers, exact time each day, as well as body temperature, blood pressure, pulse rate, and other data as to those upon whom or by whom the experimental work was being done.

INVESTIGATIONS IN MINE "ONE"

On three consecutive days, the investigators entered a mine (designated "One") for the purpose of taking data as to the effect of high temperatures and high relative humidity in stagnant air, there being no attempt at ventilation other than from compressed-air blowers, which, however, furnished sufficient air to prevent excessive vitiation. On the first day, data were taken on five subjects, A, B, C, D, and E; and on the two succeeding days on A, B, and C. No work was done other than to walk slowly a few thousand feet underground and to take the necessary readings as to temperature, humidity, velocity, and blood pressure, and in only one instance did the investigators leave the level to climb a few feet into a stope.

The compiled data taken on the three days in mine "One," show that the investigators were in the hot region 120 minutes on the first day, 90 minutes on the second, and 115 minutes on the third. It had been the intention to remain underground at least four or five hours each day, but the effect of the hot, humid, stagnant air was so great that the investigators were physically unable to remain underground much longer than the length of time indicated.

EFFECT OF HOT STAGNANT AIR

It is significant that although A, B, and C had been accustomed to go underground on investigative work regularly prior to making this investigation, at the end of the three days in this hot stagnant air, during which time a total of but 5 hours and 25 minutes were spent underground doing only such light work as walking on level ground and taking temperature, blood pressure, and other readings, A lost six pounds and B lost over five pounds in weight, and though C did not weigh, he lost perceptibly in weight, and all were seriously fatigued each day after leaving the mine.

During the three days in mine "One" there was no period during which the investigators were in temperature (either wet- or dry-bulb) lower than 90 deg. F., and in many cases the dry-bulb reading was 95 deg. F.

At all times there was absolutely no perceptible movement of air except what could be obtained immediately in the current from compressed-air blowers. Even the air from the compressed-air blowers had dry-bulb temperatures above 85 deg. F., and in many tests the air was over 90 deg. F., temperatures being taken at the end of the nozzle of the compressed-air hose. Though compressed-air temperatures were nearly as high as those of the surrounding air, the high velocity and comparatively low humidity when in the direct current gave at least a temporary measure of relief, and this constituted the only relief from the extremely depressing conditions.

The blood pressure fell decidedly when the subjects were exposed to stagnant, humid air with temperatures over 90 deg. F. and below 100 deg. F., and a marked fall in blood pressure was found immediately upon reaching the cooler, purer air of the surface after having been exposed for about two hours to the unfavorable conditions noted. For a considerable time after reaching the surface the rise in blood pressure was slow, even when the subjects took a hot shower bath with a finishing dash of cold water. It was not until after eating, an hour to two hours later, that the blood pressure rose, and then it mounted somewhat higher than before the subjects went underground.

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*Condensed from the original and published by permission of the Director of the Bureau of Mines. This preliminary study is based upon data which have in part been secured by C. A. Allen and K. T. Sparks, to whom due acknowledgment is made.

[1]U. S. Public Health Service; Chief Surgeon, Bureau of Mines.

[2]Mining engineer.

[3]Haldane, *Journal of Hygiene*, Vol. 5, pp. 494, 1905.

[4]Oliver: "Diseases of Occupation."

Body temperature rose at the rate of approximately 1 deg. F. per hour when exposed to hot, stagnant air with wet- and dry-bulb temperatures between 90 and 97 deg. F., even when no work was being done other than leisurely walking along level haulage roads. This increase of body temperature continued until 102.8 deg. F. was reached in one case and approximately 102 deg. F. in the other cases, or fever temperatures throughout. After having been underground for about two hours under the conditions described, temperature decrease took place in still surface air at about 70 deg. F. and 50 to 60 per cent relative humidity, at the rate of about 1 deg. F. per hour, there appearing to be comparatively little influence in taking the hot shower bath with the final dash of cold water.

The pulse increased rapidly upon entering and remaining in the hot, humid air, and after having been in this atmosphere for about two hours, doing little or no work, as above described, the pulse had reached as high as 130 and occasionally 140 or over. Upon returning to the surface a comparatively rapid decrease of pulse rate was noticed. It, however, did not reach for several hours the same rate as before going underground. In general, pulse rate was high in the hot, humid, stagnant air, and it seemed to be abnormally sensitive to even the slightest exercise. It was found to rise rapidly even in subjects who had been accustomed to hard work under such conditions, as well as in the subjects of this experiment.

Physical Effects Noted

During the first day, all five subjects said that they felt dizzy within twenty minutes after entering the hot, humid, stagnant air, and within an hour all felt weak. B was very nervous after an hour's exposure, and later had alternate hot and cold sensations. C had a dull headache. All subjects perspired very freely, and all appeared unable to think quickly or accurately after less than one hour's exposure. On reaching the surface, all felt well except B, who was very weak for about fifteen minutes. All five complained of feeling somewhat weak for the remainder of the day, and A, B, and C did not sleep well that night, though D and E, who were more accustomed to hard physical work, slept well.

On the second and third days, only A, B, and C went underground, and the symptoms experienced on these days were similar to those felt on the first day, but in a somewhat milder degree. However, after the three days' experimentation, in which a total of less than five and a half hours was spent underground, the exhausting effect of stagnant, humid air with temperatures between 90 and 97 deg. F. was shown in the fact that A and B (C not weighing) had each lost over five pounds in weight, though no work was done, the subjects of the test walking leisurely in unobstructed level drifts.

Observations were made on five miners who volunteered, all being healthy, robust men except V, who was pale and thin (he had worked fourteen years in this mine). While underground the men dressed in shoes and trousers or overalls, usually cut off just above the knees. Underwear or shirts were not worn. Except in case of Z, blood pressure fell perceptibly after seven and a half hours underground in humid, stagnant air with temperature between 90 and 95 deg. F. Blood pressure reacted practically to normal with W and Z after the shower bath, these two men having worked in this mine eleven days and four months respectively; and in the case of X, who had worked twelve days, blood pressure increased perceptibly after the bath. On the other hand, in the case of Y, who had worked his first day in six months, blood pressure fell perceptibly after the bath, this apparently indicating that workers who were accustomed to the conditions had acquired a degree of tolerance, or at least were not as sensitive as were the newcomers. But in the case of V, who did not bathe after returning to the surface, there was a slight drop of blood pressure. He had worked in this mine fourteen years, and was pale and thin, but was active and apparently not physically exhausted by seven and a half hours underground to the same extent as the other more robust men. His work is much less arduous than the other men's, as he is a shift boss.

The pulse rate had risen perceptibly after the men had spent seven and a half hours underground, and, except in case of W, fell quickly after they reached the surface. W showed a pulse rate increase as well as increase of blood pressure after reaching the surface. However, after having been on the surface practically one-half hour after the end of the underground shift, the pulse rate remained perceptibly above normal in every case.

How the Men Were Kept "Fit"

Notwithstanding the obviously unhealthful conditions in this mine, the miners present a generally robust and healthy appearance, this probably being due to three reasons: First, knowing the conditions, the foreman employs only strong, healthy appearing men; second, the men are never hurried or rushed by the shift boss, and in fact are told to "go easy" and "take five" frequently; third, men employed continuously in the hot, humid, stagnant air generally remain for only a few months.

The foreman said that at least 50 per cent of the men employed worked one shift or less, but that if they can last a week they usually remain several months. Though the monthly labor turnover was over 100 per cent, plenty of men were available, as the mine is close to the heart of a large mining community. The men are expected to work a seven instead of the customary eight-hour shift, for which they receive 25c. per day more than employees of neighboring mines with eight-hour shifts; and, as before stated, the workers are rarely if ever hurried by the bosses.

The efficiency of the workers is somewhat difficult to gage, but it is certainly much less than 50 per cent of that of similar workers in other mines. At working faces, while one machine man or mucker works, his companion rests in the full stream of a compressed-air blower, the men exchanging places at intervals of twenty to thirty minutes, and frequently both rest. Moreover, the man working the short interval at the face must work at reduced speed. For example, two men at the face of a drift in this mine, in still air with 96 deg. wet-bulb and 94 per cent relative humidity, muck about twelve tons per shift, though in a drift in an adjoining mine, less than 1,000 ft. away, in moving air, with 82 deg. wet-bulb and 82 per cent relative humidity, two men muck thirty tons or over per shift.

The average of about thirty readings taken at all working faces of this mine gave wet-bulb 93.3 deg. F., dry-bulb 94.4 deg. F., and relative humidity 96 per cent, and at no place was there any perceptible movement of air except at points close to compressed-air blowers. However, though the resultant conditions were undeniably

depressing, little or none of this effect was attributable to air impurity, practically no smoke was encountered, and analyses of air samples taken at working faces showed slight vitiation or none, the large amount of compressed air from blowers apparently keeping the quality of the air good, but not in sufficient quantity to give the necessary velocity to cause cooling by evaporation.

Investigations in Mine "Two"

A second series of readings was taken on two days in mine "Two," a deep mine with extensive workings. This mine, though more efficiently ventilated than most metal mines, has high rock temperatures, and practically any desired condition as to temperature, humidity, and air movement is obtainable. In the mine, the workers are supplied fresh city water at a temperature of about 65 deg. F., and the men say they can drink large quantities of the water without ill effect. They generally work in a suit of underwear, trousers, and shoes, and upon leaving the mine put on a woolen shirt and a heavy coat.

A, B, C, and D entered mine "Two" about two weeks after the completion of the readings in mine "One," spending over an hour the first day at the face of an abandoned crosscut with practically stagnant air, wet-bulb 94½ deg. F., dry-bulb 97½ deg. F., and relative humidity 89 per cent. All were dressed essentially as in the mine "One" investigation, and on the first day A, B, and C remained practically at rest for about seventy minutes. There was comparatively little change in blood pressure during the first forty-five minutes in this atmosphere *at rest,* except that the blood pressure of D fell. At the seventy-minute reading the blood pressure of A and B had fallen perceptibly, though there was little or no change as to the blood pressure of C; and D, who was the youngest and perhaps the most vigorous of the four, had slightly increased blood pressure as compared with the forty-five-minute reading, due probably to slight exercise taken just previous to the last reading.

The body temperature of the four investigators at rest at the face of the crosscut had risen slightly during the first ten minutes after entering the place, and perceptibly at the readings forty-five and seventy minutes after entering, reaching a maximum of 102.6 deg. F. with D at the seventy-minute reading, he having carried a light ladder about 50 ft. during the interval between the forty-five- and seventy-minute readings.

The maximum body temperature of A, B, and C (101.8, 101.4, and 101.5 respectively) was reached at the seventy-minute reading, and none of these men had exerted himself in the slightest other than to take readings of temperatures and blood pressure, and to record similar data. Pulse rate had started to rise slightly at the reading ten minutes after entering the hot, humid, still atmosphere, and continued to rise at the twenty-five,- forty-five,- and seventy-minute readings, except that in case of B and D there was a slight fall in pulse beat between the forty-five- and seventy-minute readings.

After having remained practically at rest for seventy minutes at the face of the abandoned crosscut in stagnant air 97½ deg. F. and 89 per cent relative humidity, all experimenters perspiring freely and having increased body temperature and pulse rate and decreased blood pressure, the men walked about 200 ft. to a point where air was being discharged from the end of a canvas tube at the rate of 2,300 lineal feet per minute, this air having a temperature of 82 deg. wet-bulb, 82½ deg. dry-bulb, and relative humidity of 80 per cent. A, B, and C stopped at the end of this pipe, D going out to the shaft station. A sat with his head in the direct air current about three feet from the end of the canvas tube; B sat at one side somewhat out of the current, C sitting out of the current twelve minutes and partly in the air current three minutes. At the end of fifteen minutes A's temperature fell from 101.8 to 100.9 deg. F., pulse rate fell from 136 to 120, blood pressure rose from 98 systolic to 106 systolic, and from 68 diastolic to 82 diastolic. Meanwhile B, sitting a few feet distant in *still* air with essentially the same temperature and humidity as that of the *moving current* in which A sat, had only a slight bodily temperature decrease of from 101.4 to 101.2, showing the decided influence of *air movement,* even when the air had high temperatures. C, also sitting near A, but within the direct air current only three minutes, showed slight increase of bodily temperature, but had marked rise in blood pressure and definite fall in pulse rate. As in similar readings in mine "One," a definite fall in blood pressure was noted immediately upon reaching the surface, with subsequent slow increase in blood pressure, which returned to normal after the men had eaten a good meal.

Physical Effects Noted

In another series of readings in which the effect of work was studied it was noticeable that there was comparatively little drop in blood presure or increase in bodily temperatures or pulse rate so long as the four investigators remained quiet in the still air with temperature 85½ to 86 deg. wet-bulb and relative humidity 96 per cent. When light work was done, such as climbing up 24 ft. of vertical ladder and then down, with eight to eighteen minutes' rest before taking readings, little or no perceptible change of blood pressure or of bodily temperature was recorded, but the men exhibited a definite increase of pulse rate. When 120 ft. of vertical ladder was climbed up and down in five minutes, with three to fourteen minutes' rest before taking reading, though blood pressure was affected only slightly, there was a perceptible increase in bodily temperature. As climbing up and then down 120 ft. of vertical ladder in five minutes cannot be called strenuous work, it is apparent that attempts at actual sustained performance of hard work under the conditions noted would result in high body temperatures.

Upon coming to the surface the readings were almost normal in all subjects, this being true of blood pressure, pulse rate, and of bodily temperature in all but A, whose bodily temperature remained over 100 deg. F., due presumably to his having exercised somewhat more strenuously than his companions had done. None of the subjects experienced unusual symptoms except A, who thought he became tired more easily than usual.

Summary of Conclusions

In still air in metal mines, with a wet-bulb temperature over 90 deg F., and under 100 deg. F., and with a relative humidity of 89 per cent or above, the following signs and symptoms were found, even when little or no exercise was taken: 1. Blood pressure, systolic and diastolic, fell rapidly. 2. Body temperature rose, and in one case reached 102 deg. F., and this after less than two hours being spent in the hot, humid

air described. 3. Pulse rate increased and seemed more sensitive to exercise than that normally found. 4. Perspiration was very profuse. 5. Dizziness was a common symptom, and sometimes was marked. 6. Physical weakness, or exhaustion, was marked in some cases and was present in all. 7. Inability to think quickly or act accurately was a common symptom. 8. Nausea was occasionally noted. 9. Headache also was occasionally produced. 10. Loss of weight was especially marked in men who have been employed under the conditions of the tests over a period of years, but occurred even after exposure for only a few days.

In still air, with wet-bulb temperatures of from 85 deg. F. to 86 deg. F., and a relative humidity of 96 per cent, there were no marked changes in the blood pressure or body temperature, nor were the symptoms mentioned in the foregoing paragraph, dizziness, physical weakness, and inability to think or act quickly, found so long as the subjects remained at rest or took only light exercise. When moderate exercise was taken—climbing up and down an 8-ft. ladder fifteen times in five minutes—the blood pressure and body temperature rose.

Blood-pressure readings taken after reaching the cool air of the surface were found to vary considerably with men unaccustomed to high temperatures. Under conditions which resulted in rise of body temperature to 100 deg. F. or more, the systolic pressure fell, but where the conditions were such as not to cause the body temperature to rise above 100 deg. F., there was a rise in the systolic pressure when the subjects reached the surface. One man long accustomed to hot, humid air, recorded a fall of systolic pressure. In three others not accustomed to the conditions mentioned, a rise of systolic pressure was noted.

The tests denoted that the body temperatures reached normal in from one to two hours after the subjects reached the cool air of the surface after having been exposed to conditions that caused a rise above 100 deg. F.

It was noted that a shower bath, beginning with tepid water and ending with a dash of cold water, had little immediate effect upon the body temperature.

Dewatering Coarse Concentrates

Such Material May Be Put in Bins and Allowed To Drain, or More Elaborate Methods May Be Employed

REMOVAL of excess water from coarse table concentrates is usually considered a simple problem, as simple as the filtering of flotation concentrates is difficult. The latter, especially when the pulp contains clay or much slime, often causes considerable trouble, and unless the mass is made more porous by the admixture of coarser material, only a very thin filter cake can be made. For this reason, in combined table and flotation plants, all of the concentrates are often run together to the filters, and, where this is necessary, the practice affords a good solution of filtration difficulties which would otherwise be encountered. However, it is a good policy to try to handle at least a part of the coarse concentrates separately, as, in themselves, they do not require filter treatment, and the smelter superintendent is always glad to have a little of the coarser material by itself to sweeten his disposition after trying to get the sticky filter cake from the cars to his roasting furnaces.

The simplest way of removing water from table concentrates is to run them into a wooden bin with enough small openings in the bottom to allow the water to drain out. In this case, however, some provision must be made to take care of the water, and conditions under the bin are very sloppy. Sometimes the planks in the bottom of such a bin are spaced an inch or two apart and the whole is covered with screening or burlap. Some of the water should preferably be removed before the material goes to the bin. One convenient means for doing this is in use at the Arthur mill of the Utah Copper Co. The table and vanner concentrates are dewatered by four three-section Dorr classifiers equipped with filter bottoms made of wire screen, canvas, and burlap, under which a slight suction is maintained. The product is quite dry, but is mixed with the very fine flotation concentrates in order to make a pulp more easily filtered.

Another means for doing the same thing is in use at the mill of the Magma Copper Co., Superior, Ariz. The Wilfley roughing table concentrates are dewatered in an ordinary Akins classifier arranged over a bin into which it discharges. The product runs about five per cent moisture, and the upkeep on the machine is slight.

At the Old Dominion mill at Globe, Ariz., a more elaborate system is used. The concentrates are dewatered in concrete tanks with bottoms covered with coco matting, a slight vacuum being carried underneath. The pulp is distributed by revolving arms so that the tanks are evenly filled. When the concentrates have accumulated to near the top of the tank, the feed is stopped and the water drained off. A plug in the center of the bottom of the tank is then pulled out, and a Blaisdell excavating machine plows the material to the central hole, through which it drops into the cars, which have been spotted underneath. This scheme has the advantage of delivering the dewatered concentrates into cars for shipment.

Iron, Zinc, and Aluminum for Coins

Germany has ceased to use silver for coinage, but is employing iron, aluminum, and zinc for the purpose. In February, 1,168,251 marks were minted in iron 5-pfennig pieces, 2,166,457 marks in zinc 10-pfennig pieces, and 3,605,137 marks in aluminum 50-pfennig pieces. The shortage of nickel and copper has no doubt precluded the use of those metals. In British West Africa, one-shilling notes have been issued as a substitute for the silver coins which have found their way into the melting pot. Twenty-five cent notes are also used to a small extent in Canada, and are convenient for mailing small remittances.

Lead and Zinc in India

The chief deposits of India are those of the Bawdwin mines in the Northern Shan States (Burma). There was estimated Dec. 31, 1917, 4,033,000 tons lead-zinc ore, assaying 24.7 oz. silver, 27.4 per cent lead, and 19.1 per cent zinc. The essential constituents of the ores are galena and sphalerite, with a little pyrite and chalcopyrite. The lead and zinc concentrates are available for the customary methods of smelting. A zinc-distilling and sulphuric-acid plant is being constructed at Sakohi, with the aid of the Indian government, to treat the table-zinc concentrate. The company operates a lead smelter at Nam-Tú, eleven miles from the mines.*

*F. B. Hyder in "Political and Commercial Geology," McGraw-Hill Book Co., 1920.

Roasting Zinc Concentrates in Suspension

New Type of Furnace, Developed at the Case School of Applied Science, Appears Worth a Trial On a Commercial Scale — Surrounding Each Sulphide Particle With Heated Air Effects Quick and Efficient Oxidation

BY CHARLES H. FULTON AND J. BURNS READ

Written for *Engineering and Mining Journal*

FINELY divided zinc sulphide ores now produced in large quantity by the flotation process may be roasted in gaseous suspension by the furnace to be described in this article. In furnaces of the ordinary type, in which the fine ore is forwarded through the furnace in the form of a shallow bed or beds, the very fineness of the ore leads to dense impervious bedding, preventing oxygen from reaching the interior of the bed, thus unduly lengthening the time of roasting and preventing the elimination of the last of the sulphur. Normally, the fineness of the concentrate should lead to a rapid and complete roast, for the speed of roasting is a function of the surface exposed to oxygen, which surface is greatest per unit of weight in very fine material.

The difficulty in bed roasting is to get the oxygen to the particle. If the fine ore during the roasting could be freely suspended in oxidizing gases, full advantage could be taken of the great surface conferred by its fineness. This principle is not new. The Stetefeldt furnace, familiar to the older metallurgists, is a classic in this respect. Nevertheless, although the broad conception of roasting in gaseous suspension is not novel, the manner in which this is accomplished may be so.

An analysis of the literature on roasting in gaseous suspension leads to the following classification of apparatus:

Class I. Furnaces in which finely pulverized ore is *dropped* into the furnace, usually of the shaft type, with or without baffles or shelves to break the path of the falling ore. There are three sub-classes:

(a) The ore is dropped from the top of the furnace against a rising current of gaseous products of carbonaceous combustion. (Examples: Stetefeldt, U. S. Patent 43,140; 72,931, reissue, 8,266; J. P. Arey, 103,066; J. H. Ray, 303,456; R. E. Wickham, 829,819.)

(b) The ore is dropped from the top of the furnace against a rising current of air. This may be accomplished by surrounding a vertical muffle with hot products of combustion and dropping the ore down the muffle; or by heating the ore first to a red heat and then dropping it down a vertical shaft. (Examples: J. S. Briggs, U. S. Patent 53,266; M. D. Brett, 188,098; J. E. Rice, 275,272; C. J. Fauvel, 503,839; C. L. Priestone, 534,517; J. E. Greenewalt, 551,725; J. E. Greenewalt, 717,093.)

(c) The ore is dropped down a shaft with the descending current of the products of combustion and air. (Examples: H. Hutchinson, U. S. Patent 414,051; A. S. Wilfley, 898,024; A. S. Wilfley, 930,254.)

Class II. Furnaces in which finely powdered ore is *blown* into a shaft or chamber which is heated by the burning of carbonaceous fuel, by coal burnt on a grate, by pulverized coal, or by oil or gas burners. In all cases the furnace space is filled with the products of carbonaceous combustion, and the ore is blown in either by hot or cold air or by steam. (Examples: J. L. Constable, U. S. Patent 39,257; Whelphley and Storer, 41,250; J. W. Bailey, 117,363; F. W. Wiesebrock, 241,108; C. E. Robinson, 246,690; H. E. Parsons, 292,944; O. H. Tobey, 315,089; W. Brueckner, 321,003; J. J. Storer, 613,828; Sutton and Steele, 729,008; L. S. Hughes, 920,333; L. S. Hughes, 920,334; J. W. Thomas, 1,084,175. Also patents 1,160,621 and 1,164,653, to Klepinger, Krecji and Kuzell for smelting furnaces in

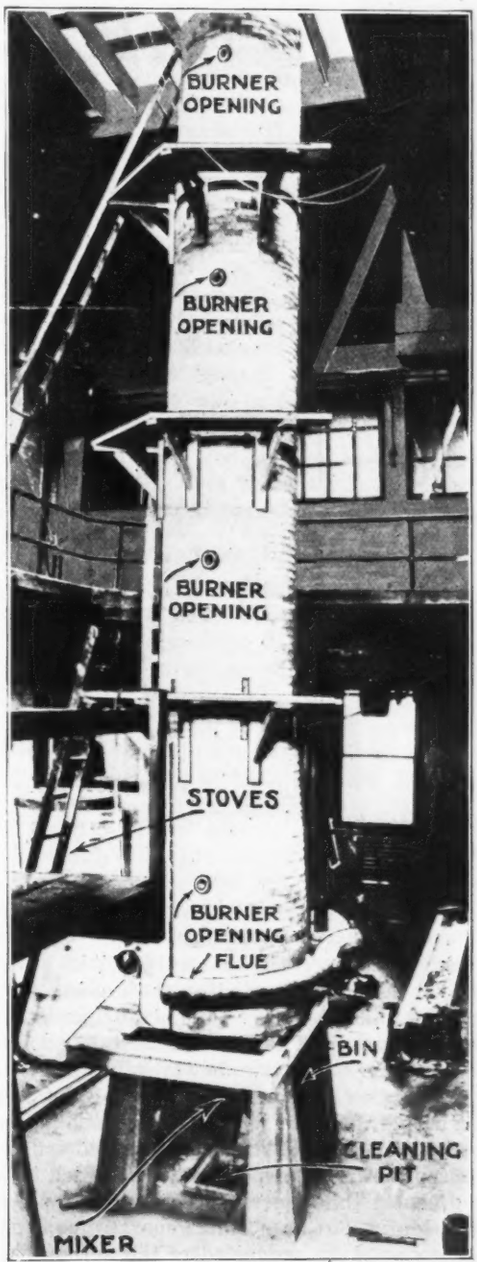


FIG. 1. 30-FT. BRICK COMBUSTION CHAMBER ERECTED IN THE CASE LABORATORY

which a mixture of ore and fuel and flux is injected by means of a burner for pulverized coal into a revolving cylinder or a reverberatory furnace by means of air, preheated in regenerative stoves.)

Class III. Roasting devices in which finely divided ore is blown into externally heated coils of pipe by means of air, hot or cold, or steam. (Examples: U. S. Patent 136,261 and 236,739.)

Former Objections to Furnaces of This Type No Longer Hold

The numerous efforts to roast in gaseous suspension point clearly to the fact that the idea is attractive; in fact, an analysis would indicate it to be the most reasonable way to effect the oxidation of ore, provided certain difficulties can be overcome. One of the objections against such a method which formerly had such weight as to counterbalance any possible advantages was that the cost of fine grinding the ore was too great, and, further, that the finely ground product, even after roasting, was unsuited for further metallurgical operations. The former objection, however, has been removed by the production of great quantities of flotation concentrate, which, in point of fineness, present a material that is ideal for roasting in gaseous suspension.

The inception of the experiments on which the information given in this paper is based is due to David B. Jones and March F. Chase[1]. The general type of furnace and the process were suggested to the authors, and the experimental work was carried out in the metallurgical laboratories of the Case School of Applied Science, at Cleveland. The fundamental purpose was to make a furnace for roasting zinc blende flotation concentrate that would use the heat value of the sulphide to accomplish the roast and to produce a gas suitable for making sulphuric acid, i.e. of sufficient concentration in SO_2 and practically free from the products of carbonaceous combustion. Auto-roasting of sphalerite is theoretically possible[2], and also practically, as was demonstrated in the experiments which were conducted.

The flotation concentrate used in the furnace was a complex sulphide containing 31.4 per cent sulphur, 44.3 per cent zinc, and 11.6 per cent iron. With good running conditions, the sulphur was reduced to 3.6 per cent, and a minimum of 2.2 per cent was obtained. Much of this, especially in the finest particles, was in the form of sulphate, due to resulphatization of the roasted ore.

A diagrammatic drawing of the roasting furnace and accessory apparatus as erected is shown in Fig. 2 and a photograph of the combustion tube in Fig. 1. In Fig. 2, *A* designates the furnace proper; *B*, the two stoves, heated by natural gas, which serve for pre-heating the air; and *C*, the Cottrell electrical precipitator for the precipitation of flue dust and fume carried from the furnace by the gases, which, in a commercial plant, would pass to a sulphuric-acid plant. *H* indicates the gas supply for the stoves, and *X*, the dust chamber. *G* is the cycloidal blower, furnishing air to carry the ore in suspension in the furnace. The dried, pre-heated ore (60 to 100 deg. C.) is charged into the hopper *I*. The screw conveyor *2*, operated by a variable speed electric motor *3*, permitting a range in the rate of feed, discharges the ore into the pipe *4*, directly above the nozzle *5*. Through this nozzle a stream of high pressure air (20 to 60 lb.), moderately pre-heated, is discharged

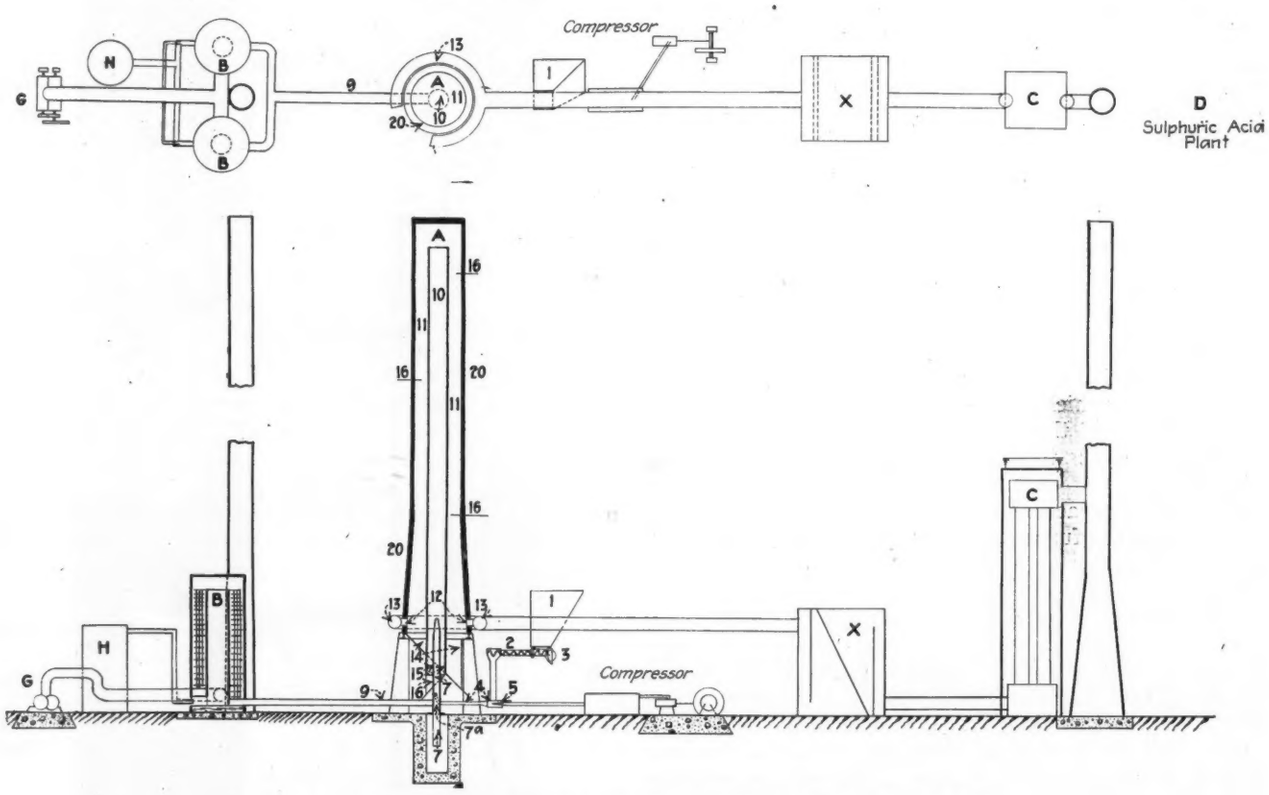


FIG. 2. GENERAL ARRANGEMENT OF EXPERIMENTAL APPARATUS

[1]The work was carried out for David B. Jones. The authors wish to make grateful acknowledgment to Mr. Jones and Mr. Chase for much aid and many valuable suggestions.

[2]J. W. Richards, "Metallurgical Calculations," One Vol. Ed. p. 620.

in only such quantity as readily to carry the fine ore in suspension through the pipe *4*, into pipe *7*, on the injector principle. Pipe *7*, of larger diameter than pipe *4*, is lined with refractory material and serves as the main injector pipe into the furnace. Air heated to approximately 800 deg. C., coming from one of the stoves *B*, enters the injector pipe *7* through the refractory lined supply pipe *9*, this being the main air supply for roasting the ore.

Regulation of Air Supply

The amount of this air supply is governed by two principles: 1. The quantity must be correct to roast the ore and to furnish a gas of the correct composition for the manufacture of sulphuric acid. Every pound of sphalerite required 35.7 cu. ft. of air (standard conditions) to convert the zinc to oxide, the sulphur to dioxide, and the dioxide to trioxide. Some excess must be carried, and, in the experiments, from 41 to 55 cu. ft., and sometimes 75 to 100 cu. ft., were used, as measured by meter. 2. Such a relation must exist between the quantity of air per minute and the area of the riser tube *10*, that the velocity of the ascending air current will be great enough to carry the largest ore particle to the top of this tube and over the edge. Fortunately, the requirements for both conditions can be fulfilled readily.

Pipe *4* enters the main injector pipe *7*, by means of a nozzle *7a*, turned upward. The mixture of ore and high-pressure air entering the main injector pipe with a rotary motion is caught by the ascending hot air from the pipe *9*, and injected into the riser tube *10*, from the mouth of the injector pipe *7*. The fundamental purpose is to have the temperature of the ore-air mixture at the ignition point of zinc sulphide, (between 650 and 810 deg. C, dependent on size of particle), as it leaves the injector tube to enter the riser tube, so that the full time of the ore particle in the furnace will be available for oxidation. After leaving the riser tube *10*, the ore particle falls in the annular space *11*, the area of this space being large so that the natural velocity of fall shall not be augmented by the velocity of the descending gases.

Time Required

The gas envelope surrounding the ore particle is probably constantly changing, fresh oxygen being supplied to the particle. The time element necessary for the roast is furnished by the time of its travel up the combustion tube and its fall in the surrounding annular space. This is controlled first by the height of the furnace, the length of travel being practically twice the height; and second by the velocity of the ascending air current in the combustion tube. Assuming a definite ratio of cubic feet of air per pound of ore, the velocity will then be determined by the area of the combustion tube. Definite figures on this point are given subsequently in this paper. In any given furnace, i.e. a fixed area of combustion tube, variation is allowable in the velocity of the ascending gas current, obtained by varying the amount of air, which will then vary the time of the ore in the combustion tube. Too high a velocity, obtained either by too much air only or too great an ore feed, with its correspondingly increased amount of air, will shorten the time element too much, so as to eliminate sulphur insufficiently.

The greater part of the ore collects in the hopper *14*, the gases and fine dust passing out through the openings *12* into the flue *13* and thence to the settling chamber *X*, where the coarser dust is settled out. The gas then goes to the Cottrell precipitator, *C*, for the precipitation of the finest dust and fume. This outlines the process and furnace.

The points of importance are as follows:

(a) The ore travels with the gases, and hence cannot be blown from the furnace before it travels the length of its path, which is essentially twice the height of the furnace.

(b) No carbonaceous gases are present, so that the SO_2 can be utilized for sulphuric acid.

(c) The ore is roasted by the heat developed by the combustion of the ore. Some fuel is necessary for preheating a certain amount of air. This pre-heated air is considered essential to obtain early ignition in the furnace, to get a complete roast. What amount of the total air must be pre-heated can be determined only by a commercial-sized furnace. The question of amount of pre-heated air is again discussed further in this paper.

(d) The furnace will make more flue dust than the usual type of mechanically operated furnace. However, this flue dust will be completely roasted, whereas in the usual type it is not.

(e) The furnace contains no mechanical movable parts in the heated zones. This means a low repair and depreciation cost as compared to the usual type of mechanically operated furnace.

(f) The labor cost will be low. One man can take care of a 50-ton furnace.

(g) The power required to operate the furnace will be about the same as that necessary for the usual type of mechanically operated furnace.

Heating the Air

Insufficient data are available with regard to how much of the air must be heated and to what temperature heating should be carried for the most efficient operation of the furnace. Obviously, one of these four methods must be used:

1. Heating all the air and passing all of it through the mixer tube and into the furnace with the ore. This will require large stove construction and will not admit of air changes in various parts of the furnace, as will be desirable for proper control.

2. Heating all the air and passing only a portion of it into the furnace through the mixer. The remainder would be put into the combustion tube at various points. This method is not desirable, as the heat is needed in the bottom of the furnace for heating the ore and bringing about early ignition.

3. Heating none of the air. Present indications are that this will not be possible, as already explained.

4. Heating a part of the air, (say one-fifth), which will be passed into the furnace with the ore through the mixer; the remainder of the air to be admitted cold at points throughout the height of the furnace.

This method will make all the stove heat available for ignition and for holding down the combustion zone, and permit the use of cold air for combustion and temperature control of the top of the furnace. Of course, the stoves should be of ample capacity and of such construction as to permit of changing the temperature and amount of air going into any part of the furnace as necessary.

Under the first condition, assuming 300 deg. C.

necessary for mixer temperature, the air in a 50-ton furnace must be heated to 350 deg. to heat the ore if it is being fed cold. If the ore is coming direct from the drier, this temperature may be reduced somewhat. Three stoves of the following dimensions should be sufficient for a 50-ton furnace: 1,060 sq.ft. heating surface, 246 flues, 4 x 4-in. cross section, 14 ft. long, and 3.25 in. walls. Total height, allowing for gas and air ports, foundation and dome, about 25 ft. Diameter, about 12 ft. Cross section of combustion chamber, 12 sq.ft.

Under condition No. 4, which seems the most promising, such stoves would be larger than required, but not necessarily inefficient, and would provide for emergencies where the heating of all the air was necessary. The ratio of fuel necessary for heating all the air to 350 deg. to that necessary for heating one-fifth to 600 deg. is about 1 to 2.5. This is a material saving in favor of the fractional heating.

Drying the Ore

Feed for this type of furnace must of course be dry, or it will not pass the feeder and injector. Most of the concentrate delivered at the roasting plant probably would have to be dried before feeding, and it was planned to do this drying with the waste heat in the gases leaving the furnace by circulating them beneath the hearth of an ordinary kiln drier. That there is sufficient waste heat available for this purpose can be readily calculated. In the experimental furnace, the gas left the furnace at 800 deg. C. under conditions of best roasting. The volume of this gas (measured under standard conditions) was approximately 50 cu.ft. per lb. of ore roasted, and was made up of about 8 per cent sulphur dioxide, 10 per cent oxygen, and 82 per cent nitrogen. The fact that sufficient waste heat was actually delivered by the small experimental furnace would seem to remove any doubts that enough heat would be available for completing the roast and maintaining furnace temperatures on a furnace of commercial size, well insulated.

The ore from the drier will contain some lumps formed in the drying and some coarse particles that will not work well in the feeder, and it was planned to interpose a vibrating screen between the drier and the feed hopper to remove these.

Capacity Varies With Size of Combustion Tube

Evidently, the capacity of these furnaces will vary as the square of the diameter of the combustion tube. This is substantiated in the results from the 9- and 12-in. combustion tubes that were used in the experimental furnace, which had capacities of 2 and 3.6 tons per twenty-four hours respectively. Assuming similar conditions as to ratio of air and ore, and the velocity in the combustion tube, the diameter necessary in the tube of a 50-ton furnace will be 45 in. For a furnace of this capacity it might be better to use two tubes of a combined area equal to 45 in. diameter, or 32 in. diameter. Such an arrangement would provide for repairs in feeders, nozzles, and injectors on a part of the furnace without complete shutting down, with attendant cooling.

Details of Probable Cost

To give figures of the cost of this type of roasting furnace and its operation that would be applicable to present conditions is impossible, and therefore only a brief analysis of cost based on pre-war conditions for a 50-ton furnace follows:

		Cost per Ton
Labor, 6 men, $19.80 for 24 hours		$0.3960
Power: compressor, blowers, drier and feeder, 26 kw.-hr. @ ¾c.		0.1998
Fuel for heating stoves (coal for producer gas)		0.0820
Interest and depreciation, figured on total costs as follows:		
Producer	$4,500	
Furnace	17,000	
Feeders	500	
Screen	500	
Drier	2,500	
Stoves	18,000	
Cottrell	12,000	
Piping and flues	800	
Compressor	1 200	
Blowers	1,000	
Housing and incidentals	7,000	
	$65,000	0.5290
General charges		0.0791
Repairs		0.1000
Total cost per ton		$1.3859

Many of the most important items in this table were taken from actual bids and were dependable for the time. Repairs, labor, and overhead cannot be definitely determined except in actual operation, but the charges given are the result of careful study and comparison. Repairs should be small compared with other types of roasting furnaces, because of the removal of all movable parts from the heated portions of the furnace. The main repairs will be in the feeder parts and injecting nozzles, which will wear because of the abrasiveness of the ore. Under continuous operation the interior of the furnace would deteriorate little. Therefore, the repair cost, like the other items, is conservative, and the total compares favorably with that of other types of furnaces now in common use.

Leasers and Lessees

An enthusiastic youngster was "Seeing America First" via the Cinderless Limited. At San Antonio the glad-hand expert of an organization of professional boosters edged up toward the good thing and permitted Bertram to break the ice. Soon the longhorn bid the attendant of the observation car to bring cracked ice and a mysterious brand of ginger ale, of which Bertram also partook. The ensuing conversation brought out the fact that a select group of Texans had acquired operating rights in a marvelously rich silver mine in Chihuahua. The narrator had just about decided to mortgage his Oklahoma birthplace, recently inherited, to equip the mine with some necessary machinery for sinking a shaft lower than the ancient workings. About a day later Bertram's father, in New York, received a message from El Paso to the effect, "Stopping over to see valuable silver mine in Old Mexico. Leasers shipping eight-hundred ounce ore from surface workings. Offer me opportunity to purchase half interest. Telegraph Frost National Bank twelve thousand dollars my credit." Father, being a methodical old lawyer, looked up the word "leaser" in the Century Dictionary, page 3,391; and then telegraphed, "Cease dealing with parties of the third part and proceed at once to Grand Cañon."

Increased Value of South African Gold

The Transvaal Chamber of Mines estimates the value of the April, 1920, output of gold at £5.125 per fine ounce, which represents an increase of £600,017 in the total value of the month's production. The amount of gold produced by the gold mines of South Africa in April was 683,962.456 fine ounces.

Prominent Metallurgical Engineers

John Brown Francis Herreshoff

IN OUR issue of May 22 we referred to "the late J. B. F. Herreshoff." "The late J. B." soon after called us up on the phone and convinced us of the truth of Sir Oliver Lodge's theories by inquiring from us if we knew the exact date of his demise. He subsequently materialized and called in person, and to the nude eye seemed not at all "late" but very much on the job. Dr. Herreshoff looks, as his photograph (taken especially for us the other day) shows, possibly a little rising fifty. He still has the biceps of our old hero John L. Sullivan, and the color of youth. When a boy he became interested in hygiene and physical culture, and he ascribes his extraordinary vigor to the pursuit of both. Dr. Herreshoff attended Brown University, and was afterward a member of the faculty, teaching chemistry. Although he did not graduate he was later awarded several degrees by that institution. Both the metallurgical and chemical professions have profited greatly from the inventions of this distinguished engineer. Younger metallurgists are probably not familiar with the Herreshoff blast furnace, inasmuch as it has been superseded by oblong furnaces with greater capacity. This was a circular, steel-jacketed, water-cooled furnace, and even more of an improvement over the old brick furnaces which it displaced than the modern furnaces are over the Herreshoff. It was designed for the Nichols Copper Co.'s Brooklyn plant but was also widely used by the Canadian Copper Co. at Copper Cliff, and in the Ducktown district in Tennessee. A feature of the furnace was a detached, portable forehearth.

J. B. F. HERRESHOFF

Better known today is the Herreshoff roasting furnace, by reason of its extensive use at the Calumet and Arizona smelter and elsewhere. Dr. Herreshoff did not like the way the rabble arms were rigidly attached to the shaft of the old McDougall roasters, and he substituted a light, hollow air-cooled shaft for the solid 8-in. shaft of the original. The principle of quickly-removable rabble arms, first devised by Dr. Herreshoff, has been widely applied.

The refining of copper was not neglected. When Herreshoff began experimenting on this phase of the copper industry, electrolytic refining was practiced only in a very small way in two different works in the United States. The present Nichols Copper refinery, the second largest in the world, is a monument to his genius. The suhphuric-acid industry has also benefited greatly from Dr. Herreshoff's inventive ability. First he greatly improved the atomizers used for the injection of weak acid into the chambers. Great improvements were also made in the Gay-Lussac towers. He then devised the Herreshoff tower, a modification of the Glover tower, of much longer life, and which permitted a much greater concentration of acid. This acid was further concentrated by a distillation apparatus of his own design. It was really in connection with pyrites burning that the Herreshoff roasting furnace, already mentioned, was developed, so that every stage of the chamber process of sulphuric-acid manufacture was much improved. Not content with this, however, he adapted the contact process to American conditions, and economized the operations to such an extent that that method of acid manufacture is thoroughly established.

Throughout his career Dr. Herreshoff has been associated with the same interests. From 1875 to 1890 he was with the firm of G. H. Nichols & Co., from 1890 to 1900 with the Nichols Chemical Co., and after 1900 with both the Nichols Copper Co. and the General Chemical Co. He is now vice-president and trustee of the Nichols Copper Co. and a director of the Granby Consolidated.

The work which Dr. Herreshoff has done has not gone unappreciated. Among other honors he was the first to receive the Perkin medal of the Society of Chemical Industry, given "to that chemist in the United States who had accomplished the most valuable work in applied chemistry during his career." This was awarded in 1908. At that time three predominant traits in Dr. Herreshoff's character were emphasized: his modesty, his simplicity as contrasted with "duplicity," and his freedom from all thought of self. "He has been a scientist in the highest sense of that term."

BY THE WAY

Experienced

The suggestion has been made to Senator Harding that, in the event of his election, it would please engineers generally if Herbert Hoover were made Secretary of the Interior. It certainly would, in our opinion. Then, too, as Food Administrator, Hoover has already had a lot to do with our interior.

What's in a Name?

The Turkey Fat concentrator near Commerce, Okla.. has been renamed the "Dinty Moore," and the Never Sweat from now on will be called the "Maggie." A third mill of the same company, now known as the "Cactus," will probably be rechristened by the operators, who are evidently admirers of George McManus and his magnum opus, "Bringing Up Father." The syndicated humor of our daily papers makes us feel at home, whether we go east, west, north or south. It is a common bond which the Reds must destrov if thev would disrupt the nation. What will happen when Mutt, Jeff, and the Hall Room Boys make their final bow? But why rename a concentrator unless it be that thus the jinx that has queered the recovery will be dispelled? Naming a mine is like naming a baby, only one need not be so careful. In a recent news item we note that "Porter & Seaman are concentrating their efforts on the Jackass mine." Such a name would never do for one's offspring, but a mine is another matter.

Diversified Industry Again

Inhabitants of desert camps need no longer fear their dependence upon the mining industry alone. A specialist in Buffalo has written an Arizona postmaster seeking five thousand pounds of snakes and offering 30 cents a pound. This, however, is an opportunity only for such camps as are favorably situated near serpentine occurrences. It will also be of benefit only so long as the market remains good. So important would be the establishing of such a supplementary industry that the *Journal's* market editor might be persuaded to quote snakes weekly, if he were approached diplomatically and a sufficient number of people appeared interested. Readers are warned, however, that no matter how firm the market stays, it is inadvisable to introduce snakes into a snakeless community and to attempt to raise them, as if they were squabs or Angora goats. Snakes excel slide rules in multiplying. But for a desert community where the snake supply is steady and not too abundant the idea is worth considering.

A Bar Story

On the loading platform of a forwarding house at old Maricopa, in Arizona, years ago, there was an imposing pile of bullion bars, each weighing about 200 lb. and each stamped as the product of a Mohave County silver mine. The pile was there for months, awaiting settlement of litigation. One morning it was noted that a bar was missing. Investigation soon showed it had been taken by two men, presumably tramps, overcome by a vision of sudden wealth. A short way westward the unweildy bar was found to have been chopped in two with a stolen axe. Each man had then staggered along under his 100-lb. load for several miles further on the way toward California. Then, the load of riches too heavy to be carried further, the half bars had been abandoned. The most interesting feature of the incident is that the glittering metal was about nine-tenths lead.

When Scot Writes Scot

A blue ribbon, if nothing more, should have been given the writer of the following letter, which was received by the manager of a certain copper company in Arizona during the war:

Pardon the liberty I take of addressing you, but I would be pleased to have you help me toward a solution of my desires. First of all, I may state that I am from the land of "peet reek" and the "Dochan Doris," and possibly this is the reason I find myself prompted to take the liberty of writing you, as I understand you are likewise from Caledonia, and therefore may be moved to a spirit of sympathy toward a fellow countryman.

On April 17 I applied to your company for a position as stenographer, and under date of April 20 received from your chief clerk the usual epitaph to applications for jobs: "Your application has been placed on file for future reference." Now, I am asking that you have your chief clerk refer to his files and show you said application, with attached references, and if you have anything to offer me, and consider same worthy of your consideration, I would be pleased to have a line from your facile pen.

I may state that I am willing to turn my hand to anything there is money in, provided the salary is, or exceeds $130 per month, and if you will bear with me a little while I will justify my statement of being able and willing to tackle "anything." In 1915 I was interested, financially, in the local agency of the ——— company at ———, being cashier, at that point, but owing to a misdemeanor of my unscrupulous partner, who absconded with our female stenographer and $1,500 of my money, I got stranded. Being at that time prompted with a desire to serve the old country, I hied myself to Galveston and joined a British ship, then requisitioned by the Admiralty, and signed on as fireman. You will agree with me when I draw the comparison between a cashier's desk and working before the blazing fires in the bowels of an ocean-going "tramp," that this demonstrates Scotch grit. After buffeting the waves for five solid weeks in one of the awfullest storms I ever saw or heard of and being chased by a "U" boat, we put into Le Havre, France, from which point we sailed up the coast to Boulogne, France. At this point I developed a fever, and was sent to a military hospital, where after spending six long weeks in bed I proceeded to my old home in Bonnie Scotland, and after recuperating there was given my passport by the Foreign Office to return to America.

I have been in office work too long and am getting somewhat tired of the confinement, and would like to get something on the outside where the remuneration is equally as good, and would therefore be pleased to have an expression from you as to whether or not you could place me somewhere over there under your jurisdiction, where there would be a chance of getting ahead, and making some money, as I need it, and need it worse, to send it to my old home, surrounded as it is by the horrors of war. As we read in Proverbs, 27-2 "Let another man praise thee and not thine own mouth," will say I can furnish additional references both as to my financial standing, and otherwise, should you so desire.

Thanking you for giving this matter your kind consideration, assuring you same will be appreciated, and with kind regards, I beg to remain,

Yours very truly,

I met a fellow here by the name of ——— (who I understand worked for you once) and his "nose is just a sicht we drink in drams" that I am afraid he will have to betake himself to that state where everybody is like unto a "camel," otherwise I am afraid he will "weaken" over here.

Hope you will not consider that I have been overbearing in these elucidations.

CONSULTATION

Concrete Furnace Hearths

"We would appreciate any information which you may be able to give us relative to the use of concrete in the construction of hearths in mechanical roasting furnaces. We are under the impression that concrete has been used for this purpose by some of the leading copper-smelting plants in the roasting of copper and iron pyrites. We would also thank you to advise us regarding the composition of the concrete used, the temperature which such hearths have stood, and the greatest period of time."

The hearths of mechanical roasting furnaces are commonly made either of fire brick or ordinary red brick. Fire brick will of course stand a higher temperature, but red brick seems perfectly satisfactory for temperatures ordinarily maintained, which will not, in general, exceed 750 deg. C. for roasting copper sulphide ore. Red brick, of course, is cheaper. Sectional cast-iron drier hearths are sometimes used, as at the Copper Queen smelter, and, if sufficient room is allowed for expansion, are satisfactory. The Copper Queen roasters, which are 8-ft. furnaces of the McDougall type, use red brick on all but the drier hearth. Concrete hearths were tried at that smelter several years ago, but would not stand the heat. Concrete hearths have also been tried and condemned by the United Verde at Clarkdale, in Wedge furnaces. The principal trouble there was that the arches swelled, allowing the rabbles to run on the hearth floor and thus wear out quickly, at the same time reducing furnace capacity. We are also under the impression that the Anaconda company once built one of its Anaconda type furnaces of concrete, with the result that it had to be shut down in a week. The company now uses silica brick of its own manufacture. The A. S. & R. Tacoma smelter tried concrete hearths a few years ago, and later threw them out.

We have heard the statement made that if concrete hearths were properly hardened and dried out before use, they would be satisfactory. Possibly some of our readers who have had success with concrete can give a more favorable account of the use of this type of hearth construction. We note that Professor Hoffman, in his "Metallurgy of Copper," states that Evans-Klepetko furnaces at Great Falls, Mont., have been successfully operated with concrete hearths, a mixture of 1 part portland cement, 2 parts tailing sand, and 4 parts crushed slag being used.

Uses of Gypsum

"Will you kindly tell me where I can find detailed information on uses, treatment, and other facts concerning gypsum?"

Gypsum has a wide variety of uses, which during the war found especial application as a structural material and as an ingredient of portland cement. Because of their light weight and fire-resisting qualities gypsum boards, blocks, and tiles are increasing in demand. Particularly in hurried emergency construction are gypsum materials favored. A building plastered with gypsum dries rapidly, enabling construction to proceed with minimum delay. Although as a plaster alone gypsum may be weak, when combined with other materials it is admirably suited for special purposes. Thus plaster board consists of sheets of gypsum plaster fabricated between sheets of some tough, fibrous binding material, such as felt.

As a fertilizer gypsum is advantageously used on some soils and crops, and may play an important part in agricultural pursuits where intensive cultivation is desired. There are other minor uses of gypsum, which, briefly and partly enumerated, are as common blackboard crayons, as a flux in certain methods of lead smelting, in filling cotton cloth and paper, as a base for paint, as an adulterant in food, in the manufacture of buttons, as a bedding for plate glass, in molds for pottery manufacture, in cheap statuary, for surgical casts, and in dental work.

The technology of the treatment of raw gypsum and much valuable information regarding the United States gypsum resources is contained in Technical Paper 155, "Gypsum Products," published by the U. S. Bureau of Mines.

Lime Production

"What percentage of lime production is used in metallurgical work?"

During the year 1918, which is the last year for which the complete statistics are available, 7.9 per cent of the domestic production of lime was used in metallurgy. The largest amount was used for construction purposes, 28.5 per cent; agriculture consumed 12.2 per cent; and paper mills 10.1 per cent. The total production, according to the United States Geological Survey, was 3,206,016 short tons.

Electrostatic Precipitation

"Does electrostatic precipitation successfully separate gases? What is the general principle upon which the electrostatic method works?"

The electrostatic processes of fume precipitation can be applied to practically every fume-carrying gas; that is, to gases in which minute particles are suspended. They will not work upon the gaseous constituents of the gas itself, except where the mixtures of vapors have different temperatures of condensation and allow the formation of mists or particles upon which the high potential current can act. Electrostatic precipitation is occasionally used in the recovery of non-ferrous smelter flue-dust, cement dust, potash fume, and iron blast-furnace dust. Through its agency, many valuable byproducts are recovered which would ordinarily be lost into the air. Essentially, the processes consist in subjecting the gas stream to a high potential electrostatic force sufficient to charge the minute particles in the stream and drive them to the suitable receiving surface of an electrode. For this purpose chains are commonly hung in pipes about 12 in. in diameter.

THE PETROLEUM INDUSTRY

Oil and Gas in Montana

A Compilation From U. S. Geological Survey Bulletins and Other Sources Describing Localities Which Contain Favorable Geological Structures and Horizons for Oil and Gas Occurrence

BY J. P. ROWE

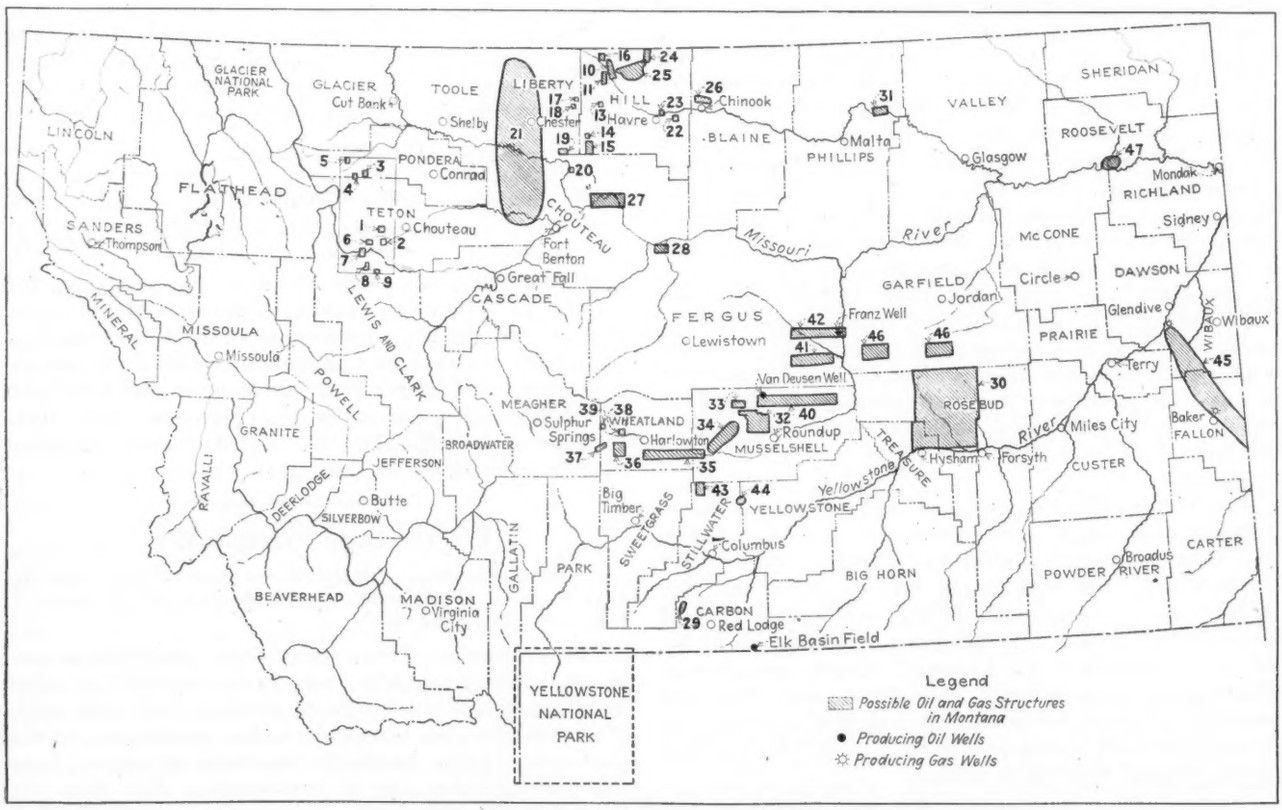
Written for *Engineering and Mining Journal*

THE MATERIAL for this article has been gathered from my field notes, from the bulletins of the U. S. Geological Survey, and from every other available source. The only detailed geological work that has been done in Montana is that of the U. S. Geological Survey. The search for oil and gas in the state has been in progress since 1900. Parties from Butte started to drill a well in that year in the northern part of Flathead County, known as the Kintla Lake district. Several thousand dollars were spent in drilling, but without success. A little later work was done in what is known as the Browning or Swift Current field, about eighty miles north of Browning.

In 1904, a well was drilled in the southern part of Carbon County on a sharply defined anticline. The crest of the anticline is in Jurassic rocks, and therefore no oil was struck, although a splendid flow of water was obtained. Somewhat later, drilling took place on what is known as the Glendive or Cedar Creek anticline, in Dawson County, in the extreme eastern part of the state. A sufficient flow of gas was encountered to be piped a few miles to Glendive, and at present many houses are heated and lighted by the gas.

About this time Havre, the county seat of Hill County, in the northern part of the state, drilled almost directly in the town and secured a fairly good flow of gas. Not long after gas was discovered at Havre several other wells were drilled in the state. Commercial gas was secured at Baker, the county seat of Fallon County. In 1914 a well was drilled at Great Falls. The well was drilled in a flat country and in the Kootenai formation and was a failure.

In 1914 a great oil excitement took place in the Sweet Grass Hills district. This locality is partly in Toole County and partly in Liberty County. The hills are three sets in number, East, Gold and West Buttes, and are laccolithic in structure. The East and Gold Buttes are several miles apart, whereas Gold Butte and West



PETROLEUM AND GAS AREAS OF MONTANA

Butte are close together. In this section conditions are favorable with respect to the geology. However, there are numerous dikes, and, while two or three wells have been drilled, no commercial oil or gas has been discovered, although a flow of gas in one or two of the wells was encountered.

In 1917, a test well was put down in the Glendive or Cedar Creek anticline at a spot selected by a widely known geologist. The company, according to reports, drilled to a depth of over 4,000 ft., going through all of the known oil or gas formations. A flow of gas was encountered at one point, but no oil of commercial value was secured.

In 1918, a well was drilled at Laurel, Yellowstone County, and it was claimed that a slight amount of oil was found. The structural conditions are such that a large amount of oil could not accumulate, as the formations are almost horizontal. There were several other rigs in the district in 1918. Wells were drilled near Conrad and west, in the Birch Creek-Sun River area, in northwestern Montana. A well was drilled to a considerable depth in Carbon County about the same time, without results. Many other wells have been drilled in the state, but, outside of Elk Basin, up to 1919 no oil was found in commercial quantities. Wells were also drilled at Twodot, Wheatland County, Wilsall; in the Shields River Valley, Park County; and also one in the southern part of Stillwater County.

Up to January, 1919, the only commercial natural oil or petroleum found in Montana occurred at Elk Basin. At this locality, in 1915, wells were drilled and a good grade of oil was secured. The Elk Basin field is partly in Carbon County, Montana, and partly in Wyoming. The field is a good producer and may be considered a part of the Wyoming field.

Since 1919 several wells have been drilled in Musselshell, Garfield, and Fergus counties. In fact, at present the area for many miles surrounding Roundup has all been leased except the land that has been withdrawn by the Government. Recently a well on Sec. 24, T. 11 N., R. 24 W. brought in oil. This well is on the Devil's Basin anticline in Musselshell County. The anticline was mentioned by C. F. Bowen, in Professional Paper 90-I of the U. S. Geological Survey. At present, it is claimed that, besides the one before mentioned, the Roundup Oil & Gas Co., well No. 1, Sec. 14, T. 11 N., R. 24 E., and the Roundup, Vandusen and Tri-City joint well, Sec. 30, T. 11 N., R. 25 E., are in operation.

The Roundup well is reported to have struck a good flow of oil, and a good flow of oil is said to have been struck on the Cat Creek anticline in the Cat Creek district near Mosby, in the eastern part of Fergus County. Great excitement prevails in the city of Roundup and in many of the smaller towns near by. An oil boom in Montana, centered around the city of Roundup, may be expected.

Geology of Oil Deposits

It is not thought that oil and gas in commercial quantities in Montana will be found lower than the Upper Carboniferous formation. At several localities where structural conditions are favorable the Upper Carboniferous is entirely missing. A general geologic section in North Central Montana above the Devonian is given in Table 1.

The eastern two-thirds of Montana is within the Great Plains region, and its areal geology, for the most part, belongs to the Tertiary or the Cretaceous formation. The great oil and gas formations in Wyoming are found in the Cretaceous, and principally in the Upper Cretaceous (Colorado and Montana) groups. Some oil has been found in the Embar (Permian) and the Chugwater, above. The oil from these latter formations is a black asphaltic oil, whereas the Upper Cretaceous rocks produce the higher grade light (paraffin) oils. The great producing horizon in Wyoming is the middle Colorado, known as the Frontier sands and shales. Elk Basin, Grass Creek, Salt Creek, Big Muddy, Greybull, and Byron domes all have their producing sands in the Frontier formation. Elk Basin, as stated, is partly in Montana.

TABLE I. GEOLOGIC SECTION, NORTH CENTRAL MONTANA

System	Series	Group and Formation	Thickness, Feet
Quaternary	Recent	Alluvium	.....
	Pleistocene	Glacial drift	0–150,
Tertiary	Pleistocene and late Tertiary	Terrace gravels	5–50
Tertiary (?)	Eocene (?)	St. Mary River formation	650
Cretaceous	Upper Cretaceous	Horsethief sandstone	250–400
		Bearpaw shale	0–500
		Two Medicine formation	1800–2200
		Virgelle sandstone	200–380
		Colorado shale with Blackleaf sand member at base	1800
Cretaceous	Lower Cretaceous	Kootenai formation	890–920
Jurassic	Upper Jurassic	Ellis formation	240–310
		Unconformity	
Carboniferous	Mississippian	Madison and later limestones	1200

Dowling, of the Canadian Geological Survey, in Memoir 52, No. 42 Geological Series, says that "Gas has also been obtained from rocks at about the horizon of the Niobrara at Medicine Hat and in southern Manitoba." He also says, "The great flows of gas at Bow Island and at Pelican Rapids, on the Athabaska, are believed to come from rocks at the horizon of the Dakota." Although Stebinger, in U. S. Geological Survey Bulletin 641, states that "It is probable, however, that this sand is actually in the lower part of the Colorado shale," the Dakota proper has not yet been recognized in Montana.

Stebinger, of the U. S. Geological Survey, in Bulletin 691-E, says, "Because of its association with the Colorado shale, the Virgelle sandstone may contain oil or gas in the rocks of northern Montana. At Medicine Hat, in the southern part of Alberta, a gas field yielding more than 40,000,000 cu.ft. daily from this sandstone has been producing for many years and has led to considerable industrial expansion in that city. More recently large amounts of gas have been obtained from the Virgelle, at Havre, Mont."

I visited the Alberta gas fields at Bow Island and Medicine Hat in 1914. During the same year I traveled across the entire State of Montana, from the Sweet Grass Hills to Marmouth, N. D. Later I spent considerable time in the oil fields of Wyoming, and from observation and all geological knowledge Wyoming Montana, and Alberta are similar geologically. Many oil wells are found in Wyoming in the same geologic formations that occur in Montana. Gas wells in Alberta are found in similar formation to those carrying gas and oil in Wyoming. If, then, as my observation leads me to believe, Montana geological formations were laid down in a similar manner and under similar conditions to the formations in Wyoming and Alberta, the conclusion might well be drawn that where structures are favorable in the geological formations above the Carboniferous, and not eroded and not too deep, dikes and faults being absent, there is reasonable expectation of finding either oil or gas.

The following are geologic formations that probably

contain oil or gas in Montana: The Kootenai—clay, shale, sandstone; the Colorado[1]—shale, sandstone; the Virgelle —sandstone (Lower Montana).

Beginning with the western part of the state, and going eastward, the significant areas will be discussed briefly. The numbers used correspond to those in the map on page 412.

Birch Creek-Sun River Area

The Birch Creek-Sun River area is described in U. S. Geological Survey Bulletin 691 E. It has a maximum length of 53 miles, running from T. 20 N. Lat. 47° 30′ to T. 29 N. Lat. 48° 15′. Its width is 21 miles, running from R. 6 W. Long. 112° 20′ to R. 10 W. Long. 122° 52′. The area is about 750 square miles.

The following anticlines in this area may contain oil or gas.

1. *Willow Creek Anticline* (T. 24 N., R. 6 and 7 W.), Teton County—According to Stebinger, an initial test well can probably be best placed in the "bad-land" area on the crest of the fold near the line between Secs. 19 and 30, T. 24 N., R. 6 W.

2. *Anticlines South of Deep Creek,* Teton County—These structures are south of the Willow Creek anticline. The westernmost anticline has its northern axis in Sec. 34, T. 23 N., R. 6 W. It continues slightly south and east for a little over three miles. The eastern anticline has its northern end in Sec. 35, T. 23 N., R. 6 W. It continues south and east for about three miles.

3. *Anticline on Dupuyer Creek,* Pondera County—Indications of a small anticline the axis of which trends about N. 17 deg. W. appear on Dupuyer Creek, near the center of Sec. 27, T. 28 N., R. 8 W. This fold is exposed only along the valley of Dupuyer Creek. At least two-thirds of the Two Medicine formation (Middle Montana) overlies the Virgelle (Lower Montana) in this locality.

4. *Scoffin Butte Anticline,* Pondera County—In the vicinity of Scoffin Butte there is a well-developed anticline the axis of which trends N. 7 deg. W. through Sec. 36, T. 28 N., R. 9 W. The depth to the Virgelle sandstone along the crest of this anticline is probably not less than 2,500 ft.

5. *Anticlines on Birch Creek,* Pondera County—Six miles northwest of the Scoffin Butte anticline there is a well-defined anticline crossing Birch Creek in Secs. 4 and 9, T. 28 N., R. 9 W., trending about N. 11 deg. W. The fold has a thick cover over the possibly productive beds, thus presenting the same difficulty as the Scoffin Butte anticline. East, one mile from the anticline just described on Birch Creek, is another small fold of doubtful value. Stebinger states that "only a very general production of petroleum in this area would seem to warrant drilling on either the Birch Creek folds, the Scoffin Butte anticline, or the fold on Dupuyer Creek."

6. *Anticlines on Deep Creek,* Teton County—On Deep Creek there are three parallel folds trending north, underlain by the Virgelle sandstone and lower formations which seem to offer the possibility of a small production of oil. The axis of the easternmost anticline crosses the creek about 1,000 ft. west of the east line of Sec. 30, T. 23 N., R. 7 W. The second anticline on Deep Creek is about 1,000 ft. west of the one just described. The third fold on Deep Creek crosses the valley of this creek near the old Goodwin ranch, extending through the southwest quarter Sec. 25, T. 23 N. R. 8 W.

7. *Anticlines on Sun River,* Teton County—There are several north-south parallel anticlines principally in T. 22 N., R. 8 W., in which the Two Medicine formation and Virgelle sandstone are the chief surface formations. The closely spaced parallel nature of these anticlines limits their collecting areas, and there does not seem to be a possibility of more than a small production of oil along their axes.

8. *Anticlines in the Vicinity of Barr Creek,* Lewis and Clark County—There are three well-defined anticlines in the vicinity of Barr Creek. Two wells were drilled on the flanks of the easternmost fold, but probably did not go deep enough to give the locality a thorough test. The easternmost anticline extends across Secs. 24 and 25, T. 21, N., R. 8 W. The second anticline in this region is found in Sec. 26, T. 21 N., R. 8 W., along Barr Creek. The third fold extends through Black Butte, in Sec. 35, T. 21 N., R. 8 W. Because of the small sizes and broken condition of this anticline it seems to offer small inducements for prospecting.

9. *Anticline in T. 20 N., R. 7 W.*—In Sec. 15, T. 20 N., R. 7 W., Lewis and Clark County, there is a well-defined anticline. This might be a fair anticline for further prospecting.

Anticlines of Doubtful Value for Oil or Gas

North of Deep Creek there are several rather large anticlines. They expose for the most part formations below the Kootenai, some being eroded to the lower Carboniferous or Madison limestone. They are, therefore, of doubtful value for oil or gas. The northernmost of the larger folds crosses the three forks of Dupuyer Creek near No Mountains and is designated the Dupuyer anticline.

The Teton anticline, lying parallel to the Dupuyer anticline, and about one and a half miles to the west, is by far the largest fold in the area.

All of the drilling has been done in the southern part of the area. None of the wells reached the Virgelle sandstone or to the probably oil-bearing beds associated with the lower part of the Colorado shale; nor were any of them located on the more favorable structural features of this area, and none of them brought in commercial gas or oil, and the district has not, therefore, been properly tested.

Anticlines in Blackfeet Indian Reservation

North and slightly west of the Birch Creek-Sun River area, running from Lat. 48° 15′ to the 49th parallel north and from the town of Cut Bank on the east, the county seat of the new County of Glacier, to the western boundary of the Blackfeet Indian Reservation, several anticlines have been described by Stebinger in U. S. Geological Survey Bulletin 641, entitled "Anticlines in Blackfeet Indian Reservation, Montana." A short description and location of each anticline is herein given, with their numbers and therefore their easy location on the map:

10. *Milk River Anticline,* Glacier County—This anticline has its northern outcrop in the valley of the North Fork of Milk River in the southwestern part of T. 37 N., R. 12 W. It extends in a southeastern direction and is twelve miles long. It is the largest single fold in the Blackfeet Reservation. The west limb of the fold near the axis of the anticline, and especially Sec. 31 and 32, T. 37 N., R. 12 W.; Sec. 27, 34 and 35, T. 36 N., R. 12 W.; and Sec. 2, 3, 11, 13 and 14, T. 35 N., R. 12 W., seem to be the most favorable localities for drilling.

11. *South Fork Anticline,* Glacier County—This anticline is second in size in the district. It lies east and parallel to the Milk River anticline. It can be traced for about six miles across the principal branches of south fork of Milk River in T. 36 N., R. 11 and 12 W., and in T. 35 N., R. 11 W. The South Fork anticline is probably as valuable as a possible reservoir of oil or gas as the Milk River fold. Stebinger states that "The desirability of prospecting in this anticline is somewhat uncertain, because of the great thickness of rocks that overlie the possible oil and gas sands." He states that "the depth to the Virgelle sandstone is over 3,000 ft. and the depth to the base of the Colorado shale nearly 5,000 ft. However, if other anticlines in this region should prove productive, drilling might be done on this fold."

[1]This formation is probably the most important source of oil and gas in northwestern Montana if not in the entire state.

12. *Blackfeet Anticlines,* Glacier County—These folds seem to offer little chance of finding oil or gas, for the reason that faults on both sides limit the collecting area for oil or gas.

13. *Anticlines on Cut Bank Creek,* Glacier County—On Cut Bank Creek, in Sec. 10, 11, 14 and 15, T. 33 N., R. 11 W., there are two parallel anticlines the axes of which trend about N. 18 deg. W.

14. *Anticline on Two Medicine Creek,* Glacier County—This fold is in the Valley of Two Medicine Creek, in Sec. 22 and 27, T. 31 N., R. 10 W.

15. *Badger Creek Anticline,* Glacier County—This fold lies in the east half of T. 30 N., R. 10 W. The crest of the anticline is so high above the oil-producing sands, and the fold so small, that this structure seems to offer little inducement for prospecting.

16. *Anticline on North Fork of Milk River,* Glacier County—This anticline lies in T. 37 N., R. 11 W., and is a very gentle fold. A well drilled to the nearest productive sands would probably have to attain a depth of 4,500 ft.

17. *Anticline on Cut Bank Creek,* Glacier County—In Sec. 34, T. 34 N., R. 9 W. is found a gentle anticline the axis of which extends north-northwestward. The axis lies approximately along the center of the valley of Willow Creek, which at this point enters Cut Bank Creek from the south. According to Stebinger, the depth to the top of the Virgelle sandstone is about 2,400 ft.

18. *Anticline on Willow Creek,* Glacier County—On Willow Creek, in Sec. 8, 16 and 17, T. 33 N., R. 9 W., there are excellent exposures of the crest of a broad, gentle anticline. To search the Virgelle sandstone a well would have to be sunk about 2,700 ft.

19. *Anticline on Blacktail Creek,* Glacier County—In the Blacktail Creek Valley, in the southeast quarter of T. 30 N., R. 8 W., a fold is clearly outlined in the upper part of the Two Medicine formation. This is a gentle fold, and to reach the base of the Colorado shale from the crest of this anticline a well would have to be sunk about 3,800 ft.

20. *Anticlines on Birch Creek,* Glacier County—This narrow-crested anticline lies in Sec. 4 and 9, T. 28 N., R. 9 W.

No drilling, so far as my information goes, has as yet been done in the Blackfeet Indian Reservation proper, though several wells have been drilled on the east, north and west border of the reservation, all with negative results, primarily for the reason that none was drilled in a locality that was most favorable and that would determine final success or failure for this section. However, Stebinger states that "The negative results obtained at these widely scattered places along the base of the mountain front, and the geologic evidence that the formations on the west edge of the reservation are much disturbed, indicate that this part of the region is unfavorable for oil and gas prospecting.

NORTH-CENTRAL MONTANA

Most of the following discussion is taken from Bulletin 641, U. S. Geological Survey, "Possibilities of Oil and Gas in North-Central Montana," by Eugene Stebinger. The article describes an area of approximately 22,000 square miles, beginning at the northern boundary of the state and running south as far as Great Falls, about 106 miles. Its western limit is R. 8 W. It extends eastward for about 192 miles to Range 24 E. It includes all of the counties of Blaine, Hill, Chester, Toole, and Chouteau, and parts of Fergus, Cascade, Pondera, Teton and Glacier.

The Kootenai formation appears to be the lowest to offer oil or gas possibilities in this section. Above the Kootenai is the Colorado shale, containing in its lower half a number of sandstone beds. Above the Colorado shale throughout north-central Montana there is a group of sandy beds from 250 to 400 ft. thick, which constitute the Eagle sandstone. The lower half is known as the Virgelle sandstone member. The Havre, Montana, and Medicine Hat, Alberta, natural gas comes from the Eagle sandstone. The higher and lower formations are probably more or less barren. The following details the characteristics noted:

21. *Sweet Grass Arch*—The western half of this area is characterized by a very broad anticline or arch. The arch extends southward from the Sweet Grass Hills to the region beyond Teton River, where it flattens out. It extends north into Canada, and the Bow Island gas field in southern Alberta lies near the center of it. The arch for the most part has not been examined geologically, and therefore the occurrence of minor folds has not been determined. Should such folds be found within the arch, they offer the possibility of getting oil or gas from the Colorado shale at comparatively shallow depths.

22. *Box Elder Anticlines,* Hill County—There are two parallel anticlines near Box Elder Creek extending across Sec. 8, 9, 16 and 17, T. 32 N., R. 17 E. Their limits on the northwest and southeast are not determinable, because of the cover of the glacial drift, but they are doubtless parallel to the Meili fault, and their extension toward the immediate vicinity of Havre, where the large quantity of gas has been found, is probable.

23. *Havre Natural Gas Pool,* Hill County—The principal gas well of the Havre Natural Gas Co., brought in early in July, 1915, is in the S.E. ¼ Sec. 33, T. 33 N., R. 16 E., about two miles northeast of Havre, just south of the Great Northern Ry. This well is 947 ft. deep, and had a flow of 10,000,000 cu.ft. in twenty-four hours. The pressure was about 490 lb. to the square inch in 1915. The gas pool in the district of Havre will probably have its greatest extension in a direction S. 70°-75° E.

The probable reason for the failures of wells drilled at Fort Assiniboine, Chinook, and other localities in the Milk River Valley was the lack of knowledge of the kind of structures to drill and of the disregard of expert advice.

24. *Signal Butte Anticline,* Hill County—This structure is in the west half of T. 37 N., R. 15 E. It extends in a direction approximately N. 25° W., and is broken along its crest by a fault.

25. *Hill County*—In many places north of the Bearpaw Mountains there are areas of tilted and folded rocks. The following localities are the most noted: T. 37 N., R. 15 E.; T. 36 N., R. 14 E.; T. 35 N., R. 12 E.; T. 35 N., R. 14 E.; T. 35 N., R. 16 E.; T. 34 N., R. 12 E.; T. 34 N., R. 13 E.; T. 34 N., R. 14 E.

26. *Tilted and Folded Rocks North of Chinook,* Blaine County—On Lodge Creek, in the southwestern part of T. 34 N., R. 19 E.; on Battle Creek in the northeastern part of T. 33 N., R. 19 E.; on Coal Creek, in the west half of T. 33 N., R. 20 E.

27. *Area of Tilted and Folded Rocks South of the Bearpaw Mountains,* Chouteau County—In the vicinity of Virgelle, in T. 26 N., Rs. 11 to 13 E., there are four areas of tilted rocks.

28. *Tilted Rocks of Lower Part of Judith River,* Fergus County—In the north half of T. 22 N., R. 16 E., there is an extensive fault and southwest of this fault there is a very large block.

29. *Oil Prospects in the Upper Stillwater Basin,* Stillwater County—Some years ago several holes were put down in the Upper Stillwater region. All the holes were dry, according to Calvert, although indications of oil were reported. One locality was in the northeastern part of Sec. 4, T. 6 S., R. 18 E., and the other in the S. E. ¼ Sec. 32 of the same township. After passing through surface wash and the lower sandy portion of the Eagle sandstone, the drilling was in dark shale and thin sandstone, presumably of Colorado age. It seems that this section of the southern part of Montana was not properly tested, for the reasons, first, that the holes were of insufficient depth, and, second, because they were put down on the pitching end of the anticline. Another well was drilled at Dean during the summer of 1917. It is reported that it went to a depth of about 1,800 ft. It was a dry hole.

30. *Possibilities of Oil in the Porcupine Dome,* Rosebud

County—The Porcupine dome lies north of Forsyth, east of the Chicago, Milwaukee & St. Paul Ry., and includes T. 7 to 12 N., R. 36 to 40 E. The dominant structure is that of an elongate, roughly triangular dome the outline of which is indicated by the inner margin of the Judith River formation. Within the margin the dome has a maximum north-south diameter of about thirty-three miles and a maximum east-west diameter of twenty-seven miles. Minor folds exist within the domed area. C. F. Bowen says, after a general discussion for and against conditions in this dome, that "The presence or absence of oil or gas in the Porcupine dome field can be demonstrated only by thorough and systematic exploration with the drill. The only positive statement that can now be made regarding their possible occurrence is that the structural and stratigraphic conditions are favorable for their accumulation." The most promising place, according to Bowen, is near the crest of the uplift on the divide between Porcupine and Little Porcupine creeks, probably T. 10 and 11 N., R. 38 E.

31. *The Bowdoin Dome*—This dome is situated on Milk River, partly in Phillips County and partly in Valley County. It is a broadly arched structure from which the strata dip away on all sides. This dome was described a few years ago by A. J. Collier, and a description of it may be found in Bulletin 661-E of the U. S. Geological Survey. The Bowdoin dome is large and of low dip. Collier states that the most favorable place to drill is near the northwest corner of T. 32 N., R. 33 E. Whether a test well has since been put down in this region I do not know. While drilling for water several years ago a small flow of gas was struck at a shallow depth. I do not look with much favor upon the Bowdoin dome, for the reason that the dip of the strata is entirely too low. The size of the Bowdoin dome compares favorably with the size of the Porcupine dome, Rosebud County.

Anticlines in a Part of the Musselshell Valley

In Bulletin 691, U. S. Geological Survey, Bowen describes the anticlines, and the following is taken largely from this bulletin. The area described in Bulletin 691 includes about 1,200 square miles lying chiefly in T. 7 to 9 N., R. 12 to 23 E. Montana principal meridian.

The Musselshell Valley is structurally part of a large syncline that lies between the Big Snowy and Little Belt Mountains on the north and the Crazy, Beartooth and Pryor Mountains on the south and southwest. There are many minor folds within this syncline caused by the compression of the rocks. The most prominent anticlines and domes are described in the following:

32. *Pole Creek Anticline*, Musselshell County—This structure has an extent from northwest to southeast of about sixteen miles, occupying the area from the north side of T. 8 N., R. 24 E., to the southeast quarter of T. 10 N., R. 22 E., where it loses its identity in the south limb of the Devil's Pocket anticline. It is not known whether the axis of the Pole Creek anticline merges with the south limb of the Devil's Pocket anticline or whether the two folds are more or less distinctly separated by a syncline. This relation is critical, for on it may depend the possible accumulation of oil in the Pole Creek anticline. So far as its relation to other structural features is concerned, the Pole Creek anticline is well situated. It has a large collecting ground to the northeast, east, and south. To the southeast the area is small, because of the close proximity of a synclinal axis in that direction. The most unfavorable factor to be weighed in this anticline is the possibility that the oil may have escaped in the direction of the Devil's Pocket anticline. In the opinion of Bowen, the Pole Creek anticline is worth testing.

33. *Devil's Pocket Anticline*, Musselshell County—This anticline is nine miles long and three miles wide. It lies north and west of the Pole Creek anticline, principally in T. 10 N., R. 22 E. It projects from the Big Snowy Mountains, and is open in that direction. In other directions its outline is marked by the Eagle sandstone, so that the Colorado shale is the surface formation over the entire basin. Therefore, this anticline is not a likely source of oil unless the sands below the Colorado are productive, and it is faulted off on the north side and the productive sands have been sealed along the fault plane.

34. *Woman's Pocket Anticline*, Musselshell County—This anticline is about eighteen miles long from northwest to southeast and a little less than four miles wide. It lies southwest of and parallel to the Pole Creek anticline, but, unlike that fold, it has a "closed structure." It occupies portions of T. 7, 8 and 9 N., R. 20, 21 and 22 E. Regarded as an isolated anticline, it seems a favorable one for oil accumulation, as the possibly productive sands in the Colorado are covered and sealed above. It has not, however, a large collecting area.

35. *Shawmut Anticline*, Musselshell County—This anticline is the one mentioned in the Musselshell Valley. It has an east-west extent of about thirty miles and a maximum width of more than eight miles. That part of the anticline east of and including Deadman's Basin is the most favorable place for testing and is the only one that is likely to produce oil from the sands of the Colorado. In the western part of the Shawmut anticline there are three small domes, the east, middle, and west. The east dome is a possible source of oil, if oil has accumulated in the Kootenai sands. All three of the domes present ideal structure if oil is ever discovered in this section in rocks older than the Kootenai.

36. *Big Elk Dome*, Wheatland County—This dome covers an area of approximately one township and lies a few miles south of the town of Twodot. The structure of the dome is almost ideal, but as the most promising sandstone in the Colorado, the Big Elk Member, is exposed in the center of the dome, and as the underlying sands are probably quartzitic and fine grained, it does not seem likely that oil or gas will be found in this formation. The Kootenai sands might be productive.

37. *Little Elk Dome*, Meagher and Wheatland Counties—This structure lies between Little Elk and Fawn Creeks in T. 7 N., R. 11 and 12 E. It has an east and west extent of about eight miles and a north-south extent of four miles. For the reason that the sedimentary rocks are cut by several dikes and masses of igneous rocks, and the most favorable sands of the Colorado are exposed in the center of the dome, it is not probable that oil will be obtained in this dome.

38. *Haymaker Anticline*, Wheatland County—This anticline lies chiefly north of Twodot. Its structure is not "closed." The chances for oil in this anticline are small.

39. *Daisy Dean Anticline*, Wheatland County—The anticline lies five or six miles northeast of Martindale. It is not regarded as being favorably situated for oil accumulation.

In Professional Paper 90-I, U. S. Geological Survey, C. F. Bowen mentions briefly anticlines and domes north and east of the folds described in Bulletin 691. These structures lie in Fergus and Musselshell counties, and are found on the broad symmetrical fold, the Big Snowy anticline. The axis of the Big Snowy anticline trends northwest and pitches to the southeast. The minor folds on the Big Snowy anticline are the Devil's Basin, Flat Willow and Cat Creek anticlines, with intervening synclines. They are symmetrical folds the axes of which pitch to the southeast and trend roughly northwest but are somewhat sinuous in outline. The dips on opposite limbs of the folds as a rule range from two to six degrees and rarely exceed ten degrees. Descriptions follow:

40. *Devil's Basin Anticline*—The fold is in Musselshell County, running through T. 10 and 11 N. and R. 24, 25, 26, 27, 28 and 29 E. At present the greatest development is in T. 11 N., R. 24 E. This is the location of the Van Dusen well, which recently brought in oil, and also of several other wells that are now being drilled.

41. *Flat Willow Anticline*, Fergus County—North of the Devil's Basin anticline, in Fergus County, is the Flat Willow anticline. The fold is but a few miles south of the town of Winnett, and Smith post office is situated directly

upon its crest. It passes through T. 13 and 14 N., and R. 26, 27, 28, and 29 E. The Eagle sandstone is the surface formation over its western portion; the Claggett outcrops over most of the eastern half.

42. *Cat Creek Anticline,* Fergus County—The crest of this fold is north of Winnett about eight miles. It runs through T. 15 and 16 N., and R. 26, 27, 28, and 29, and probably 30 E. It is recently reported that about six miles from Mosby, Fergus County, oil was struck in a well drilled on this fold. It is reported that a 600-bbl. well was brought in across the Musselshell River on March 17. The lands on and surrounding the fold are being or have been leased.

Lake Basin Field

In Bulletin 691, U. S. Geological Survey, E. T. Hancock has an article on the "Geology and Oil and Gas Prospects of the Lake Basin Field." This field is situated in south-central Montana, and includes portions of Sweet Grass, Stillwater, Musselshell, and Yellowstone counties. It embraces an area of about 1,000 square miles. It lies south and east of the Musselshell Valley area, which is mapped and described by Bowen in Bulletin 691.

The two dominating folds in the Lake Basin Field are the Big Coulee-Hailstone dome and the northwest end of the Big Horn Mountain anticline. The highest point of the dome appears to be near the center of the east side of T. 4 N., R. 19 E., and from that place the dome is somewhat elongated in the direction of the Broadview dome, a local uplift about seven miles southwest of Broadview. Only the Big Coulee-Hailstone and the Broadview domes will be discussed.

43. *The Big Coulee-Hailstone Dome*—The highest point of this dome is considered to be near the center of the east side of T. 4 N., R. 19 E., Stillwater County. There is little doubt that the formations present in north-central Wyoming which carry oil and gas extend northward and underlie the Lake Basin field. It is also reasonably certain that the sandstones in the Colorado and Kootenai formations are sufficiently near the surface to be tested by the drill under the most favorable structural features in the Lake Basin field. The principal element of uncertainty for oil is the nature and extent of the sands. From the number of well logs available it appears that well-defined sandstones such as those present in most of the productive Wyoming fields are lacking in the Lake Basin field. It may be, however, that the available drill records fail to represent the true nature of the Colorado sands and that future drilling will establish the existence of sandstones under parts of the Lake Basin field similar to those underlying certain portions of the Musselshell Valley, farther north.

From the well logs it appears that no sandstones were encountered comparable with those at Elk Basin, Wyo., and apparently only meager showings of oil and gas were obtained. In view of the size of the Big Coulee-Hailstone dome, and the location of the 79 Oil Co.'s well and the well in Sec. 17, T. 3 N., R. 21 E., in relation to the crest of the dome, together with the fact that many dry holes are found even in productive fields, it is reasonable to conclude that further drilling of the Big Coulee-Hailstone dome is justified.

44. *The Broadview Dome*—About seven miles southwest of Broadview there is a circular uplift which may be called the Broadview dome. This dome is crossed by the boundary line of Stillwater and Yellowstone counties. Its crest is in Sec. 13, T. 3 N., R. 22 E. The Eagle sandstone outcrops over nearly the entire dome. The dome is greatly faulted on its southeast side. Hancock states that "if the Big Coulee-Hailstone dome proves barren, the possibilities of oil and gas in commercial quantities in this dome and the Lola Basin field are believed to be very slight."

45. *Cedar Creek Anticline,* Prairie and Fallon Counties—In U. S. Geological Survey Bulletin 471, U. R. Colvert briefly described this anticline. He states that "a strongly pronounced anticline extends from Yellowstone River near the mouth of Cedar Creek southeast for about seventy miles into the Dakotas." The same anticline is briefly described on pp. 51 and 52 of the University of Montana Studies—Series No. 1, by J. P. Rowe and Roy A. Wilson. From developments since both of these articles were written, the presence of oil is extremely problematic, although the cities of Glendive and Baker are now supplied with natural gas from this structure. As previously stated, a deep well was drilled, a year or two ago, in a most favorable locality on the anticline, with negative results in respect to oil, although a good flow of gas was struck in one or two places.

46.—According to Bowen, in Professional Paper 125-B, U. S. Geological Survey, there are several local anticlines in T. 14 N., R. 32 and 33, 37 and 38 E. These are north of the Porcupine dome and east of the Flat Willow anticline, as previously described. The anticlines are in the Lance formation, and the distance to the Colorado might be of disadvantage in drilling. They are in the southern part of Garfield County near the Alice and Garfield post offices.

47. *Poplar Dome*—In Professional Paper 120, U. S. Geological Survey, Arthur J. Collier mentions the foregoing, although C. D. Smith had noted the same structure several years previous in the U. S. Geological Survey Bulletin 381. Neither writer considers the Poplar Dome, or others which are in the surrounding country, as possible reservoirs for oil or gas. It seems, however, that this dome, unless it has too low a dip, has some promise, for the reason that it "brings up a large elliptical area of Bearpaw shale nearly surrounded by the Lance formation." The dome is a few miles east of Wolf Point, on the Great Northern Ry. The town of Poplar is, according to Smith, near the center of the dome.

48. *The Huntley Field*—There is an anticline south of Ten Mile Creek, in the western part of T. 1 N., R. 30 E., and the eastern part of T. 1 N., R. 29 E., partly in Yellowstone and partly in Big Horn counties. For several reasons this locality does not seem to promise much in the way of commercial oil.

49. *Wolf Point*—South of Wolf Point, in the northern part of McCone County, there is a low structure. It is found largely in T. 25 N., R. 46 E. Owing to its low dip, I do not look upon it with much favor.

The most recent U. S. Geological Survey bulletin on oil and gas in Montana is No. 711-G. It deals with the "Geology and Oil and Gas Prospects of the Huntley Field, in Yellowstone County." This bulletin mentions two or three structures where oil or gas might be found, but gives no special encouragement, for the reason that commercial oil or gas has not yet been discovered in the Lake Basin field.

Natural-Gas Curtailment

Conference of State Public Service Commissions Likely To Result in Restricting Supply to Domestic Requirements

By R. S. McBride

Written for *Engineering and Mining Journal*

PRIORITIES in natural-gas supply similar to those which are from time to time confronting petroleum interests are to be considered on Sept. 10 by a conference of five of the state public service commissions, which meet to decide important policies with respect to elimination of certain industrial users of natural gas. Fundamentally, the question is how to supply the domestic users whose requirements are practically equal to the total production during peak-load periods. The most obvious method is the elimination of industrial users, and unquestionably those who use natural gas under boilers of any appreciable size, and many industrial users in brick manufacture, glass making, carbon-black production, and ceramic industries, are to be affected.

The state commissions involved are those of Pennsylvania, West Virginia, Ohio, Maryland, and New York. The first three named have jurisdiction over districts where 70 per cent of the natural gas in the United States is consumed. Fig. 1 (prepared by E. G. Severs, of the U. S. Geological Survey) shows the importance of this particular territory.

The action of these commissions will, it appears, be based upon the resolutions recently adopted by the national committee on natural-gas conservation, which worked under the auspices of the Department of the Interior, and reported June 11, giving recommendations for the conservation and distribution of the available natural-gas supplies.

Pooling of Interests Will Eliminate Wasteful Oil-Field Methods

One phase of the situation which probably will not receive immediate attention, though it has often been discussed in this connection, is that of the pooling of field interests. Fig. 2, a chart by S. S. Wyer, shows the importance of this, for under the competitive conditions described, it is quite apparent that wasteful field methods in natural-gas development have been encouraged. Only by the pooling of interests in adjoining territory can these problems be solved sucessfully, it is claimed.

The immediate importance of attention to these matters is evident from Fig. 3 (also by Mr. Wyer), which shows the rapid decline in daily production of gas in the McKeesport, Pa., field. Other fields in this tri-state territory have not shown such striking declines, but in each case the production shows signs of early diminution.

Industrial users who can demonstrate special requirements for natural gas which are not easily met by other fuels will have to be prepared to make such demonstration to the state commissions at an early date, as otherwise they can expect that their natural-gas supplies soon will be ordered cut off. For example, it is claimed that certain glass-making processes, such as flattening and annealing of plate glass, require sulphur-free fuel, and for such work it is quite possible that continued service will be permitted.

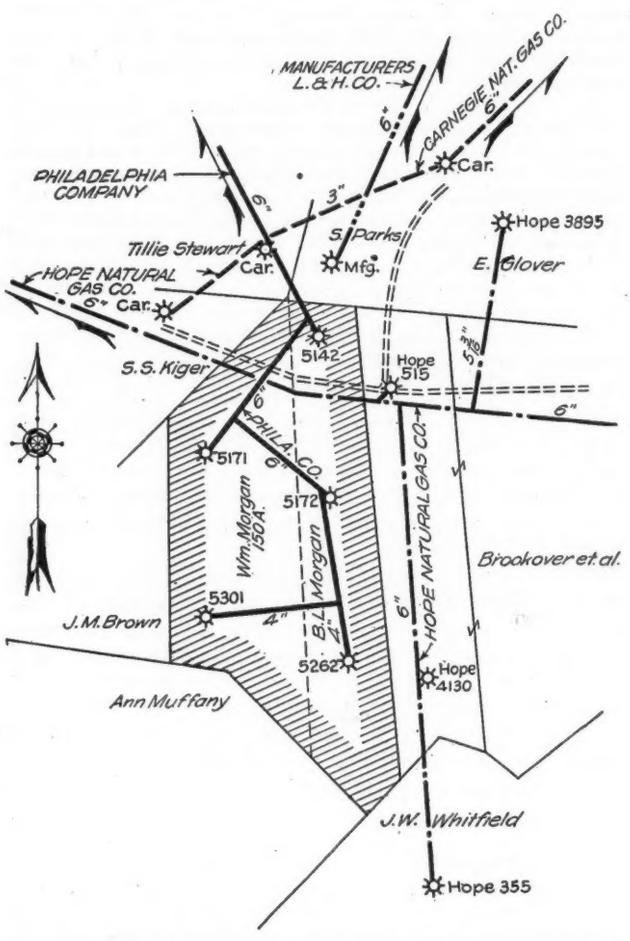


FIG. 2. SKETCH SHOWING COMPETITIVE CONDITIONS IN A NATURAL-GAS FIELD

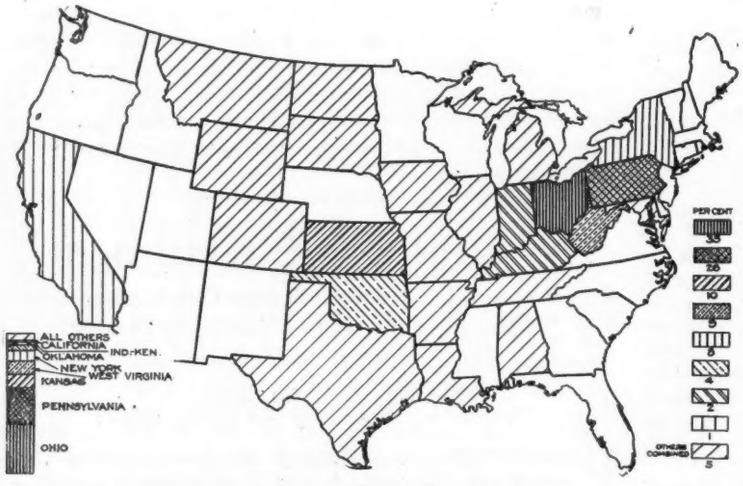


FIG. 1. MAP OF THE UNITED STATES, SHOWING BY STATES THE PERCENTAGE OF NATURAL GAS CONSUMED FOR DOMESTIC PURPOSES FROM 1906 TO 1918

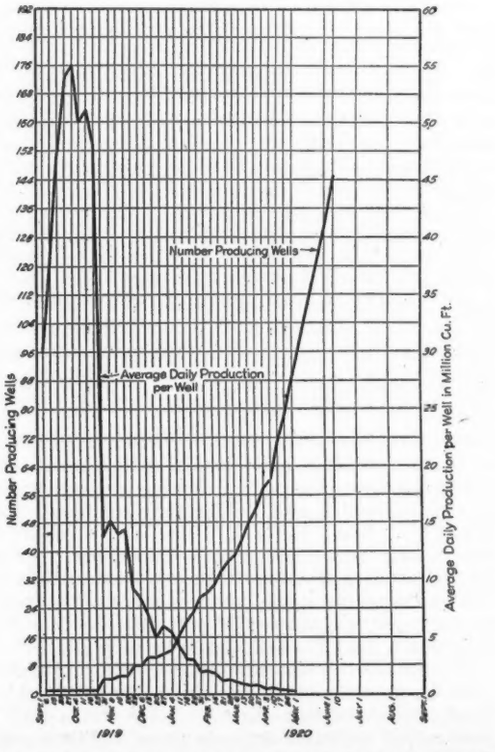


FIG. 3. DECLINE IN McKEESPORT NATURAL-GAS FIELD

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Council Seeks Advice on Classification of Engineers

Claims Question of Satisfactory Pay for Engineering Service Affects Public Most

Administrative officials of the various states and cities of the country, as well as of Federal bureaus having jurisdiction over engineering work, together with Civil Service Commissioners, were recently addressed by Engineering Council's Classification and Compensation Committee in an effort to secure their advice as to the practicability of putting the committee's proposed classification of engineers into effect in their various organizations. They were sent the following letter:

"It is doubtless known to you that engineers in all branches of the profession have suffered serious hardship during the past three years from the great decrease in buying power of the dollar. In few cases has their pay been increased sufficiently to offset any large proportion of the increased cost of living.

"Engineering Council, which represents over 45,000 engineers in all parts of the United States, has had this matter under investigation for over a year. We send you herewith an abstract of the report of the Council's special committee on the Classification and Compensation of Engineers. This report contains a standard classification of grading for engineering service, with a tentative schedule of standard rates of compensation in each of the proposed grades.

"Engineering Council has approved this classification, and it is believed to be applicable to all branches of engineering service.

"The classification was endorsed by the municipal engineers of the City of New York at a meeting of that society held on May 26, 1920, at which time a schedule was adopted providing for compensation at a rate approximately 20 per cent greater than that tentatively suggested by the committee. The classification has been closely followed by the Congressional Joint Commission of Reclassification of Salaries in its recommendations concerning engineers in the Federal service (see *Engineering News-Record*, April 15, 1920), and it was approved by the executive committee of the American Society for Testing Materials on April 13, 1920. The endorsement of the tentative schedule of compensation was recommended to the Boston Society of Civil Engineers by its Committee on Compensation at a meeting of that society held on May 19, 1920, and is now being made the subject of a letter ballot by the full membership. It will thus be seen that substantial progress has been made in bringing about a recognition of Engineering Council's classification as standard.

"The adopted classification and the corresponding schedule of compensation tentatively suggested are as follows:

Adopted Grades	Tentative Compensation Schedule
Junior Aid	$1,080 to $1,560
Aid	$1,680 to $2,400
Senior Aid	$2,520 to $3,240
Junior Assistant Engineer.....	$1,620 to $2,580
Assistant Engineer	$2,700 to $4,140
Senior Assistant Engineer.....	$4,320 to $5,760
Engineer.....	$5,940 and upwards
Chief Engineer ...	$8,100 and upwards

"We desire especially to urge upon you that this question of satisfactory compensation for engineering service is one which affects the public even more vitally than it does the engineers themselves. Upon the quality of service rendered by the engineers who design, plan and execute construction work, its cost and serviceability will largely depend. Our investigations have shown that the public is already suffering loss as a result of the great reduction in engineers' compensation.

"The need of a standard classification and standard rates of compensation which would be generally recognized as fair and just has long been felt by public authorities and other large employers of engineering service. We believe that this report is worthy of your very careful attention. In nearly all work on which technical engineering service is required, its cost is a very small percentage of the entire cost, so that an increase of engineers' pay to the standard scale will add a hardly noticeable amount to the total, and this in nearly all cases should be far more than offset by the economies which a higher grade of engineering service can effect.

"Nor can the importance be overlooked, at this time of general industrial and social unrest, of maintaining the loyalty of professional men who should be leaders of thought and action to the organizations which they serve. This continued loyalty to professional ideals cannot be expected when men of education and intelligence receive lower pay than many unskilled laborers."

The Mining and Metallurgical Society of America recently announced that the Gold Medal of the society, which will be awarded at the annual meeting in January, 1921, shall be given for: "Distinguished service in increasing the safety of men in mining and metallurgical operations."

Actualities in Industrial Russia Described by Expert

Raw Materials Stores Exhausted—Food and Fuel Vanishing—Disease Rampant

Many people are wondering "What the truth is about Russia." The *Compressed Air Magazine* publishes under the above title an account by one who has spent many years in Russia and, until the Bolshevik era, was associated in Petrograd with a well-known manufacturer of compressed-air machinery. Chaotic industrial conditions in 1917 put an end to this business, but he elected to remain in the country, hoping for improvement; and later he was unable to receive permission to leave. He has just succeeded in getting out of Russia, and has written an interesting description of conditions. We are sorry that we cannot quote the whole article.

"Everyone must be employed by law, particularly males from sixteen to fifty years of age; but to work according to the usual conception of the term simply is not done." They prefer to sit around, smoke, discuss their love affairs and how one can get something special to eat. "The educated middle-class school teachers, clerks and office assistants are having a very difficult existence because the brain-worker is very much underpaid."

The writer secured a job, through influence, in a chemical factory. Owing, however, to the complete lack of raw materials "this industry is at present at a complete standstill, except for the fact that the entire force of laborers and staff were maintained at full strength, doing very little. This factory has about 100 laborers on the payroll who worked only every once in a while at tearing down wooden structures and houses in the vicinity for the lumber, conveying it to the factory premises, where it was redistributed amongst the employees for use as firewood."

This is also the condition in other industrial establishments. "The Obouk-hoff Works are engaged only in repairing railway cars, no new cars are being built, because the necessary raw material and coal for fuel are lacking."

" . . . In order to obtain firewood, all wooden houses, fences and other structures in the vicinity of the factories are torn down, and forests lying within an area of 20 versts (12 miles) radius from Petrograd are being felled, converted to firewood and transported to the factories and immediately consumed." In fact all has been consumed, as if by a pest of grasshoppers. "Now that the Bolsheviki have rounded up and consumed all known accumula-

tions of foreign supplies and stocks of raw materials, I do not hazard a guess as to how they shall be able to carry on in the immediate future. Everything seems to be lacking; nothing, absolutely nothing remains. I never could have believed that a country could be stripped so completely bare as has been accomplished in Russia within the relatively short period of two years that the Bolsheviki have been in power."

It is quite impossible to subsist on salaries of 5,000 to 8,000 roubles per month; one must have 30,000 to 40,000, and even so will not get enough to eat. Butter is 8,000 roubles per pound; bacon 2,500 to 3,000 roubles; one egg 200 roubles; flour at 800 roubles per pound; and so on. "In our family we had the good fortune to live in a house where the water pipes had not yet been burst by the frost, but in all neighboring houses it was necessary to carry up the water all the way from the street. . . No buildings are being repaired or maintained in condition, there being neither labor nor materials available for this purpose." Housing is governed by a special Soviet committee. "One room is allotted for an individual and so my parents with a family of three, who occupied a five-room apartment, were forced to take in two sailors as lodgers. . . . As things are, no one attempts to move, there being, in addition to the foregoing troubles, a great scarcity of lodging, due to the fact that almost all wooden houses have already been torn down and used as firewood; and also the luxury of moving costs from 20,000 to 30,000 roubles."

As far as wearing apparel is concerned, that is out of the question. A pair of shoes costs 12,000 to 15,000 roubles; overshoes from 9,000 to 10,000 roubles. These may be obtained from sailors, who are favored by the government. "In the month of February, 1920, the 'Skorokhod Shoe Factory' produced only enough shoes to enable them to negotiate an exchange for overshoes for themselves with the workers of the 'Treugolnik Rubber Factory.'"

There is, however, one flourishing industry: "Of all the industries in Russia, the state plant of printing and engraving reaches the greatest degree of efficiency, and is working to full capacity. Here the money or leninki is produced. Operation goes on day and night and printing proceeds without interruption. The workers in this plant are shown every consideration."

Of the city of Petrograd, a desolate picture is painted.

"Nevsky Prospekt, once Petrograd's pride [Petrograd's Fifth Avenue, and about four miles long], is now nothing but a country road. All shops have been closed and the windows sealed up with boards; the wooden paving blocks have long since been torn up (for fuel). . . . The sidewalks are crowded with degenerate loafers supposed to be soldiers, or Soviet employees. . . . Along its entire length there are not more than ten tiny little shops still open."

Hackmen are scarce. "A truck driver charged 12,000 roubles to haul baggage from the Vassili Ostrov to the Finnish Railway Station. . . . Street cars were still running when I left, but most of them were broken down, and of the former 800 motor trams only about 100 are able to maintain operation. . . . There are only two passenger trains a week between Petrograd and Moscow and they take from five to seven days for the trip, formerly a ten-hour run, being about 400 miles."

However, life is not without its brighter sides. "All theatres are working full blast, and doing a tremendous business. Seats cost from 125 roubles up, and at the Mariensky all seats are permanently taken up by Communists of high rank, so that mere mortals are never so fortunate as to obtain admission, unless, just as in the former days of the Imperial Government, it is possible to procure the influence of some one of powerful position, with the exception that your protector will now possibly be a letter-carrier, whereas formerly he had to be at least a general. The audiences are mostly made up of sailors, soldiers and their feminine appendages. The women are loaded down with jewelry, and the new Mariensky Theater frequenters attempt to ape the brilliant audiences that formerly thronged the building."

There are, however, certain drawbacks. "Apropos of vermin . . . tram cars, railway cars, theatres, prisons, and hospitals swarm with them, and people are dying by hundreds of thousands on their account. In February of 1920, 65,000 died of spotted typhus in Petrograd."

Behold the "New Freedom" of the idealist: "The passport system has been re-established and is even stricter than it ever was during the days of the Imperial Government." "Petrograd has been policed for some time by girls of from 17 to 25 years of age. Male militiamen are rarely seen, because all able-bodied men have been drafted into the Red Army."

As to profiteers: "Running down speculators is a leading passion of the Bolsheviki, but it is to be recorded with sorrow that the worst offenders in this direction are frequently to be found among their own kind, such as unimportant Kommissars, sailors and factory workers originally sent by their own organizations into the provinces in order to obtain produce but who then refuse to relinquish any part thereof, without being assured a personal graft of several hundred per cent."

All schools are free, and literacy has been made mandatory by the government, "but this order, the same as others like it, is universally ignored and the masses remain just as uneducated as ever, only they are by far more rough and cruel. The way things are arranged, it is even possible for any one who is literate to receive what passes for an engineer's diploma after going through a course of study lasting four months."

Institute of Electrical Engineers Becomes Charter Member of F. A. E. S.

At the meeting of the Board of Directors of the American Institute of Electrical Engineers held in New York City recently, the following resolution was unanimously adopted:

"Resolved, That the American Institute of Electrical Engineers accepts the invitation to it to become a Charter Member of the Federated American Engineering Societies, and pledges its hearty co-operation in the work thereof."

This action brings up the present membership of the federation to four societies: American Society of Mechanical Engineers, Detroit Engineering Society, Technical Club of Dallas, Texas, and the American Institute of Electrical Engineers. There is no question as to whether the organization will be formed; the Federated American Engineering Societies already is the largest engineering organization in this country.

Emergency Currency of Madagascar

The *Bulletin du Commerce*, Nouméa, New Caledonia, for July 2, 1920, reports that in Madagascar the shortage in money is being met by using postage stamps. Adhesives are attached to one face of a piece of cardboard bearing on its other face an inscription stating its value, and the whole is given a coat of varnish. These "tickets" are issued in denominations of .05, .10, .25, .50, 1 and 2 francs. When badly soiled or damaged by usage "tickets" are redeemed gratis at any post office. This currency is reported meeting with success, and to be preferred by the natives over nickel coins.

In Papeete, Nouvelle-Caledonie, and Tahiti, the chambers of commerce are putting out paper coupons (coupures) as in France herself, and Nouméa has also decided on this course. The expense of printing an adequate supply of coupons in the United States (200,000 were printed for Papeete) is inclining these colonies toward the Madagascar plan.

The Minnesota Federation

The movement to federate the engineers and the allied technologists is to again bear fruit. Engineers and architects from all parts of the State of Minnesota met at Duluth, Minn., recently and took the first steps toward the formation of a state federation of engineers and architects. It is presumed that this organization will become a member of the Federated American Engineering Societies and it is hoped that the action in Minnesota will be followed by similar action in other states; only through united action of this character can the full strength of the solidarity of the engineering and the allied technical professions be realized.

Book Reviews

The Ore-Deposits of Utah. By B. S. Butler, G. F. Loughlin, V. C. Heikes, and others. Professional Paper 111, U. S. Geological Survey. 1920. pp. 659, 9 x 11¼. Price $1.50, from the Superintendent of Documents, Washington, D. C.

We are glad to hail this substantial volume as in our opinion the most notable contribution to economic geology, and perhaps to geology in general, for the year. The geology of Utah is broadly discussed, necessarily involving considerable space, but the language is compressed to a laudable extent. The authors have, to be sure, had the advantage of all the preceding geological studies made in Utah, yet much of their material is original, and more of their deductions are. We recommend students, in and out of universities, to use this work as one of the textbooks of economic geology. We would furthermore suggest to the authors that an abridged edition, leaving out the descriptive part, still further boiling down the rest, and including all the pertinent illustrations, would be well worth while.

In his explanation of the origin and interrelation of most of the ores of Utah, the senior author presents the most elaborate array of facts yet put forward in support of the theory of ore deposition suggested by Spurr in 1904 (p. 200), although since that time many facts and deductions supporting the theory have been presented by numerous geologists, notably (and early) by Sales, at Butte; and also from time to time by the proponent of the theory. The theory argues for the origin of vein-forming solutions as the siliceous extreme differentiation product of crystallizing magmas; and for the successive deposition, with decrease of temperature and pressure, of different metals from these residual solutions. Mr. Butler, however, adds much that is partly or wholly novel in the way of searching analysis and thoughtful deduction. One line of thought, in which Mr. Butler is one of the pioneers, if not the pioneer, is in regard to the economic significance of different horizontal sections of igneous stocks or laccoliths as now truncated by erosion:

"Ore deposits associated with the laccoliths and deeper truncated stocks are of comparatively slight commercial importance, and those associated with the apically truncated stocks are of great value."

This is a classic proposition. We have not tested this in the field, as Mr. Butler has, but the course of reasoning seems sound; and if corroborated in other districts this has a direct and important economic application in prospecting and mining. We should like to have the author develop more clearly the field criteria by which we may know an apically truncated stock from a more deeply truncated one. Certain criteria suggest themselves at once; but in many instances it occurs to us that the distinction may be perplexing. Another valuable generalization, valuable in any case as a working hypothesis, is that the deeper truncated stocks are uniformly the more siliceous. "The apically truncated stocks range in composition from monzonite to diorite and the deeper truncated stocks from granodiorite to granite" (p. 20). This in itself would be a criterion of the truncation horizon, if demonstrated; and is also, as the author points out, a feature supporting the general theory of the origin of ore solutions by magmatic differentiation. Still lower, more basic phases would be expected, according to the author's reasoning.

Other sapient suggestions, among many which the author has put forth, without transgressing from bold inductive reasoning to unfettered fancy, are that "fractures in passing downward should disappear at a level where the material was too liquid to retain a fracture at the time they were formed" (p. 199). There will be many other reasons for "bottoming" a vein, of course, but this deserves to be held in mind. Also that "the extent of the ore deposits associated with laccolithic bodies, other things being equal, is dependent on the size of the laccolith" (p. 198).

A very valuable presentation is that of covering primary sulphates, including gypsum and alunite, as a deposition from magmatic emanations (pp. 181-195). This should be read by every student.

We congratulate the authors at having put the "contact deposits" in their proper position with other mineral deposits. "It is believed that the solutions producing the two types of deposits had a common origin. If the solutions forming the contact deposits and the deposits in the intrusive rocks had a common origin they resulted from differentiation of the magma that formed the main intrusive bodies" (p. 174). We also congratulate them on their sturdy advocacy of intrusion by dynamic force, instead of the "stoping and assimilation" theory, though we should have advised them not to discuss theories for which they find no evidence. There are too many "snakes in Ireland" essays in geological literature.

It is natural, perhaps, as in the above case, to pay at least the deference of opposition to current theories, and in obscure cases to let current theories stand. Nevertheless we wish to protest against the discussion of the "Basin range structure" question, on which the intimidation of authority has procured the acquiescence in views beyond the authors' knowledge. No proof is given of the conclusions as to the ranges having their relief due directly and primarily to faulting. It may or may not be true; possibly in some cases true and others not—certainly the evidence cited in this volume does not support the theory. Some day we hope to see this subject discussed more from a scientific and less from a spiritualistic standpoint than is now the general custom. Visions are swift, and observation is slow. Things like this are airy nothings: "The Sevier Valley, in its middle course at least, has been considered as resulting from the settling of a block between two great faults, forming a fault valley or graben." Geological literature is rotten with faults that "ain't there." For example, we quote from Memoir 117, Canada Department of Mines, 1920 (S. J. Schofield[1]) p. 62:

"The origin of the Purcell trench has been described by Daly[2] in the following words: 'The Rocky Mountain trench and the Purcell trench are likewise located on zones of profound faulting: in each case the constructional profiles may have been grabens as typical as that of the middle Rhine or that of the Dead Sea.' The geology of the Purcell trench in the neighborhood of the international boundary line was worked out in greater detail by the writer in 1913 and *it was found that the faults marked by Daly on the geological map as occurring on each side of the Purcell trench were not present and that the valley in this locality was not a graben.*"

We wish we had space to mention a few more of the good things in the volume: the description and interpretation of the folding, for example—an earlier east-west compression, marked by overthrown folds and faults; and a later series of vertical, in part domical uplifts, with or without faulting, due to a series of general east-west igneous intrusions. We suggest to Mr. Butler in this a possible answer to our east-west vein conundrum, set forth editorially in our issue of Feb. 28.

J. E. S.

Mine Bookkeeping. By Robert McGarraugh, E.M. Cloth, 6¾ x 9¼, pp. 118. McGraw-Hill Book Co., New York. Price $2.

In his introduction to this little volume the author states, "The segregation and distribution of cost data is essentially an engineering undertaking, and, as such, should be under the supervision of some one who is familiar with all phases of the work and who clearly understands the results which are desired." This summarizes the intent and purposes of the book, for Mr. McGarraugh has presented his subject matter in a suggestive way which is open to such elaboration as the engineer may devise for his own particular needs. The essentials are not lacking, and the work is most acceptable, as it gives a comprehensive outline of bookkeeping and accounting methods applicable to the requirements of mining operations as carried on by the smaller and less well-organized companies.

[1]Schofield, S. J.: Geol. Surv. Can. Sum. Rept. 1914, p. 41; Geol. Surv. Can. Mem. 76, 1915, p. 168.
[2]Daly, R.: Geol. Surv. Can. Mem. 38, pt. 2, 1912, p. 600.

MEN YOU SHOULD KNOW ABOUT

G. R. Mansfield is making geological field studies in southeastern Idaho.

W. P. Cloonan has resigned as mill superintendent of the Yellow Pine Mining Co. at Goodsprings, Nev.

C. E. Dobbine has been assigned to geological reconnaissance work in the Powder River region of Montana.

J. H. McLean, general manager, spent Aug. 4 and 5 at the Gogebic and Marquette range mines of the Oliver Iron Mining Co.

H. D. Miser is acting chief of the section of iron and steel alloys of the Geological Survey during the absence of E. F. Burchard.

Dorsey A. Lyon, supervisor of stations for the Bureau of Mines, is paying official visits to the Bartlesville and Pittsburgh stations of the Bureau.

Joseph F. Kunesh, who has been in charge of the office of the U. S. Geological Survey at Tucson, Ariz., has resigned to enter private employ.

Robert G. Wilson, formerly with the Tonopah-Belmont Mining Co., has been placed in charge of the taxation division of the American Mining Congress.

John D. Northrup, of Cheyenne, Wyo., was in New York recently, and expected to sail on Aug. 28 for Peru, where he will spend two years in oil-field examinations.

C. W. Newton, general manager of Consolidated Interstate-Callahan Mining Co., has returned to Wallace, Idaho, from the recent directors' meeting in New York City.

Edward Packard, who controls the Gemini and neighboring properties in Eureka, Utah, has been there recently conferring with the managers in charge of his interests.

J. R. Finlay, of New York, was on the Gogebic Range from August 6 to August 11, having driven there from the copper country, where he has been professionally engaged.

T. F. M. Fitzgerald, for some years with the Tonopah Belmont Development Co., is now in charge of the Homestake Placer Co. operations at Copper Canyon, near Battle Mountain, Nev.

C. Y. Hsieh, a member of the Geological Survey of China, has been employed temporarily by the U. S. Geological Survey and assigned to work with A. E. Fath in the Lost Soldier oil field of Wyoming.

Harry J. Wolf has been retained as consulting engineer to the Richard D. Wyckoff Analytical Staff, and will go West late in August to investigate mining properties in the interest of the staff's associate members.

Alex Grosberg, has resigned his position with the Patino tin mines, Uncia, Bolivia, and has accepted the general managership for D. G. Bricker, mine operator at La Paz. Mr. Grosberg sailed for Bolivia on July 28.

C. D. Woodward, chief electrician of the Anaconda Copper Mining Co., with headquarters at Butte, was recently at the Walker mine in Plumas County, Cal., to inspect the electric haulage tunnel which has been installed there.

Paul Moore, director of War Trade Board's information bureau, becomes secretary of research extension division, National Research Council, next October. He will give special attention to the promotion of research with reference to the industries.

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H. A. C. JENISON

H. A. C. Jenison, of the U. S. Geological Survey, who was recently assigned to assume charge of copper statistics, is in the West making a statistical and general study of our larger copper mines. His advance statement of the copper production of the United States in 1919 has just been distributed.

Bruce Middlemiss, assistant manager of the Chile Copper Co., visited in Hibbing recently after a three years' absence in South America. He was formerly general superintendent of the Mesabi Range operations of the Dean Iron Co. Mr. Middlemiss will return to South America early in September after several months' stay in the United States.

T. Nelson Dale, geologist, of Springfield, Mass., who retired from the U. S. Geological Survey on August 21, has spent six weeks this summer in active field work, collecting material for his bulletin on the limestones of Massachusetts, eastern New York and western Connecticut. Mr. Dale has also completed a revision of his work on New England's commercial granites, and a bulletin on southern commercial marbles.

J. W. D. Moodie, for many years general manager of Britannia Mines, has resigned and was succeeded on August 1 by **B. B. Nieding**, a mining man now living in Washington State. Mr. Moodie will take a long holiday and will go to California to reside. He has been in charge of operations at Britannia during the era of greatest development there and the company now owns a zone from Howe Sound to Indian River, at the northern end of the north arm of Burrard Inlet.

OBITUARY

F. L. Barker, mining engineer, and professor of mining and geology in Pei Yang University, Tientsin, China, died there on June 9, 1920, of smallpox. Professor Barker had taught in that university for the past five years, and had held a similar position in the University of Oregon from 1908 to 1913.

SOCIETY MEETINGS ANNOUNCED

Independent Oil Men's Association will hold its 12th annual national convention and a petroleum exposition at Denver, Col., on Sept. 28 to Oct. 1 next. The program includes, besides numerous characteristic hospitalities, cinematograph demonstrations of today's oil industry at work, an address of welcome by Governor Shoup, and communications on "International Aspect of the Oil Industry" by Van. H. Manning; "Specifications and Nomenclature," by W. F. Parish; "Production," by J. O. Lewis and A. W. Ambrose; "Present Condition of the Shale Industry in England and Scotland," by V. C. Alderson; "Relation of Bureau of Mines to Oil Industry," by F. C. Cottrell. Headquarters will be at New Albany Hotel, Denver, Col., and the sessions will be held at the Denver Auditorium Building, Curtis and Champa Streets. Secretary E. E. Grant's address is 110 Westminster Building, Chicago, Ill.

The Sixth National Exposition of Chemical Industries, at Grand Central Palace, New York City, Sept. 20 to 25, inclusive, has accepted nearly 400 applications for space. The program, aside from the exhibition proper, is also extensive. The American Institute of Chemical Engineers will hold a meeting in the Palace Sept. 23, and interesting papers will be read. In the evening the engineers will have a dinner at the Technology Club. Three other symposiums will be held during the week, one on fuel economy, one on materials handling, and one on industrial management.

A feature of this year's exposition will be moving pictures showing how American chemistry has advanced and the difficulties that have been overcome.

THE MINING NEWS

LEADING EVENTS

Lawsuit Outgrowth of Cuyuna Range Transaction

H. J. Kruse Seeks Share in Royalty on Ore Land Deal from C. D. Tripp, Former Partner

Claiming that he has been defrauded of valuable royalty rights in property on the Cuyuna Range in Minnesota by the manipulations of his former business associate, Henry J. Kruse has brought suit in district court at Duluth to recover from Chester D. Tripp, of Chicago, $219,744.35 damages. The purchase, optioning and leasing of eighty acres of mineral land in Crow Wing County is involved and dates back to 1910 and 1911 when Tripp and Kruse were both employees of the Rogers Brown Iron Co. In his complaint Kruse claims that on May 21, 1910, he purchased the surface rights of the eighty acres of land described as the south half of the northwest quarter of Sec. 11, 46-29, Crow Wing County, from a farmer with the intention of platting it into townsite and selling lots. Kruse alleges that, pending the closing of this deal, he was informed by Tripp that the latter was negotiating for the purchase of a mining option on a property lying west of the eighty-acre tract and that he would want the surface rights to the property which Kruse had purchased. Kruse claims that at that time it was not known to anyone that there was ore on his property and that it had no apparent value except for platting purposes.

The plaintiff alleges that he was induced to enter into an agreement to let Tripp handle the property on shares, Tripp having informed him that the mining company had abandoned all plans with regard to the eighty. He further alleges that the first arrangement was that Tripp was to handle the sale of the property on equal shares, but that later Tripp informed him that it would be necessary to handle it on thirds and still later on fifths in order to put the deal over through the agency of the Soo railroad. Believing Tripp, he agreed. Later, he alleges, Tripp induced him to deed away his surface rights to the Soo railroad, it being understood that he should receive $6,400, after which the surface rights would be deeded back to him less a strip for right-of-way. This was done in accordance with the plans and after deducting $1,655.65, the original cost of the property to him, he turned the balance of the $6,400 over to Tripp for negotiating the deal.

Kruse claims that Tripp then secretly negotiated with the Weyerhauser interests for an option for lease which later ripened into a lease through which Tripp was to receive 10c. per ton on all ore mined, all of which was part of a fraudulent scheme to cheat him out of his property. Kruse holds the value of the property, out of which he claims to have been defrauded, to be $219,744.35, including interest accrued.

WEEKLY RÉSUMÉ

Manganese ore from Brazil has arrived at Mobile, Ala., for consumers in the Birmingham district. In the Minnesota iron country, suit has been brought by H. J. Kruse against a former partner, C. D. Tripp, to recover a share in royalties from an iron ore land transaction on the Cuyuna Range. In the Joplin-Miami district, the Baker-Howell mine, near Baxter Springs, Kan., has been sold. Zinc operators are seeking to relieve the pressing car shortage by cutting the time in half allowed for unloading. The mine safety contest recently conducted in the Butte district has been won by the Emma mine.

In Washington the U. S. Bureau of Mines has selected Tuscaloosa, Ala., as the site for the new southern mine experiment station. The U. S. Geological Survey is planning greater activity for its foreign minerals section. Frank L. Hess, of the Survey, has returned from Bolivia.

Joplin Zinc Operators Seek To Relieve Car Shortage

An attempt to relieve the car shortage in the Joplin-Miami district is being made by operators through efforts of their own. Ordinarily freight cars that come into the field loaded with coal or other material are given four days for unloading. The mine operators, by mutual agreement, are endeavoring to cut this period exactly in two. Many coal cars are being unloaded at night and loaded with zinc concentrates the following day. An appeal for this effort on the part of the operators was made by Lee Willius, chairman of the car committee of the American Zinc Institute, at the meeting on August 18, and was met with prompt reponse on the part of the operators.

Emma Mine Wins Safety First Contest at Butte

The Emma mine, operated by the Anaconda Copper Mining Co., but owned by the Butte Copper & Zinc Co., was adjudged the winner of the safety-first contest recently held in the Butte district, extending for a period of 30 days. The Emma scored no accidents and was awarded a pennant by C. F. Kelley, president of the Anaconda. Even a scratch suffered by the miners was reported. During the period of the contest accidents in the Butte mines were reduced two-thirds. Sixteen of the mines in the district engaged in the race.

Baker-Howell Mine, Near Baxter Springs, Kan., Sold

Sale of Zinc Property Marks Activity in District Resulting from Chanute Spelter's Rich Strike

Sale of the Baker-Howell mine, situated in Oklahoma about three miles south of Baxter, has been announced. E. R. McClelland and J. W. Perry, of Kansas City, were the purchasers and the price paid is said to have been $50,000. The mine has been developed by T. B. Baker and John W. Howell, principal owner and manager, respectively, of the Connor hotel at Joplin. For a long time development of the property was handicapped by heavy water, but the pumping operations of the Chanute Spelter Co. at its Hartley mine, about two miles to the northwest, solved this problem, and the Baker-Howell Co. had recently been showing a profit on operations with hand jigs only. The new owners, who have operated successfully in this district, plan to erect a concentrator immediately. Their properties also include the St. Regis No. 1, at Duenweg; the No. 2, at Joplin, and the Quebec and Commonwealth mines at Picher.

This sale is the principal feature of the increasing activity in the Baxter camp, following the rich developments at Chanute Spelter Co.'s Hartley mine. At this latter property a drill hole has recently cut rich ore, indicating the existence of an entirely separate orebody from that being worked at present. The company is making approximately 75 tons of concentrates per day, operating single shift, and easily double that could be made, it is said.

Henry Ford Mum on Mining Plans in Michigan Iron Country

Now that Henry Ford has purchased the 400,000 acres of the Michigan Land & Iron Co. in northern Michigan, and is to start a large factory at Iron Mountain, Mich., on the Menominee Range, mining men are wondering what he is to do with the mineral holdings which have come into his possession. There are a few mines which have been worked, including the Imperial, at Michigamme, on the Marquette Range, a producer of limonite ores, and the U. S. Steel Corporation holds the lease on a deposit in the village of Alpha, near Crystal Falls, which has never been touched except by drills. Some of the lands are very likely iron ore, but no statement has been made by Mr. Ford regarding his mining plans. He has furnaces near Detroit and it is believed that he will later enter the mining field.

Manager of Esperanza Co., El Oro, Held for Ransom, Then Released

Captured by Pedro Zamora While on Examination in Jalisco — W. A. Gardiner Still Held by Bandit

Charles Hoyle, general manager of Esperanza, Ltd., of El Oro, Mex., his wife, and W. A. Gardiner, mill superintendent for the Esperanza company at El Oro, were reported on Aug. 21 to have been captured in Jalisco several days before by the bandit, Pedro Zamora, and held for ransom. Mr. Hoyle and a party of diamond drillers had gone to Jalisco before the Zamora revolt to inspect some properties there. Late reports had it that the rest of the party escaped.

An Associated Press dispatch, dated Mexico City, Aug. 23, announcing the release of Mr. and Mrs. Hoyle, reads as follows:

"Pedro Zamora has released six of the Americans who were kidnapped recently by him in the State of Jalisco, but is holding one American, W. A. Gardiner, superintendent of the Esperanza Mining Co., for 100,000 pesos ransom, and W. B. Johnson, a British subject, for 50,000 pesos, according to advices received here today.

"Charles Hoyle, manager of the Esperanza Mining Co. at El Oro, said to be a nephew of John Hays Hammond, and Mrs. Hoyle have been released and are now safe at Penas, on Banderas Bay. The names of the other four Americans set free by Zamora are given as Dietrich, Gillis, Culvert and Nels. These four are at Mesa del Corazon."

The Mexican Embassy at Washington admitted on Aug. 14 that a rebellion against the De la Huerta government had started in the State of Jalisco, the leader of the rebels being Pedro Zamora. It was then stated that the president had ordered 7,000 men to be sent to Jalisco under General Enrique Estrada to quell the rebellion.

Northern Light Title Dispute Decided

The case of C. W. Montague against S. P. McDonald and others, involving the title to what is known as the Northern Light mine, 14 miles from Yerington, Nev., has been decided in favor of the defendants by Judge Emmet Walsh, who has had it under advisement since it was tried some months ago. The mine was at one time under bond to the Mason Valley Mines Co. The plaintiff has asked for a new trial and states that he will appeal if it is denied.

Stockmen in southeastern Arizona have found a menace in the abandoned mine openings of the section, asserting that the old tunnels are the natural winter abiding places and summer breeding grounds of the blowfly, now menacing their herds. It is suggested that all such unused mine openings should be closed tightly.

Manganese Ore from Brazil for Birmingham District

Received at Mobile, Ala.—Intended for Tennessee C. I. & R. R. and Southern Manganese Companies

A shipment of 7,000 tons of high-grade manganese ore arrived recently at Mobile, Ala., bound for the Birmingham district. This ore will be used by the Tennessee Coal, Iron & R.R. Co. and the Southern Manganese Corporation. It is to be transferred to barges, which will come up the Warrior River and also to railroad cars. These shipments from Brazil will continue now that transportation facilities up into the district have been established.

The Government is taking steps to erect a big coal storage plant at Mobile, to handle coal shipped down from the Birmingham district on the Warrior River to permit the coaling of ships touching at that port. A portion of the storage plant is to be set aside for the ore that will be imported. With this apparatus in use unloading the ships and loading the ore on railroad cars or on barges for the river traffic, much expense and trouble will be overcome. The Southern Manganese Corporation has a plant at Anniston and is operating steadily, its product being taken by the Tennessee Coal, Iron & R.R. Co. almost exclusively.

To Study Ore and Peat Reserves on Minnesota State Lands

The committee of the Minnesota senate in charge of the state ore lands has established headquarters at Hibbing, Minn., and will spend considerable time investigating the ore and peat reserves on state lands. It is proposed to enact legislation at this year's session placing the remaining unsold state leases on mineral lands on the market. The leases have been off the market for thirteen years and if they are again offered for sale it is probable that the terms of the lease will be changed. One of the most interesting suggestions for the new leases is that royalties be based on a sliding scale. Under this proposal all ore on state lands would be classified as to quality and accessibility and royalties paid accordingly. Shipments from state properties during the last week totaled 204,745 tons of which the Missabe Mountain pit, at Virginia, shipped 94,944 tons.

Bulkeley Wells To Start Dredge at Dayton, Nev., Soon

September 5 is the date set for beginning operations with the big dredge that has been installed in the placer fields near Dayton, Nev., by Bulkeley Wells and associates. It is planned to make it a gala occasion. Mr. Wells and many of his friends will make the journey to watch the dredge start scooping up the gold-bearing gravel, and, of course, the Governor will be there to make a speech. It was at this place that gold was first discovered in Nevada.

Ontario Mining Association Meets in Sudbury

Members Visit International Nickel's Creighton Mine—New High Falls Dam Completed

The Ontario Mining Association, whose membership comprises over 95 per cent of the operating mines of the province, had its first general meeting in Sudbury on Aug. 17 and 18. The members were the guests of the International Nickel Co., who arranged a visit through the Creighton mine, the smelter and the power plant. The Creighton is supposed to be the largest high-grade mine in the world. Ore reserves are between twelve and fifteen million tons, and the ore carries between 5 and 6 per cent combined copper and nickel, in the proportion of two parts nickel to one of copper. At the present time about 3,000 tons per day is being hoisted and passed through the rock house, and 2,500 tons per day are being shipped to the smelter. At the power plant at High Falls, about 25 miles from the town of Copper Cliff and the smelter, a new storage dam is practically completed. This dam, while not quite so high, is longer than the famous Roosevelt dam in the Southwest, and when completed is expected to cost about $3,000,000. It is of the latest type of construction, and when the storage reservoir is filled with water, a lake 25 miles long will be formed.

On the following day a number of the members stayed over to accept the invitation of the British America Nickel Corporation to visit its mine and smelter at Nickelton.

Recent Production Reports

Calumet & Hecla produced 8,312,025 lb. copper in July. Production by subsidiary companies was as follows: Ahmeek, 1,572,838; Allouez, 262,400; C. & H., 4,684,972; Centennial, 34,600; Isle Royale, 775,200; La Salle, 0.; Osceola, 735,900; Superior, 85,800; and White Pine, 160,315.

Wolverine produced 246,343 lb. copper in July, against 327,683 in June. Mohawk's output in July was 698,558 lb. copper, compared with 754,304 in June.

Burma Corporation produced 3,416,000 lb. refined lead and 190,070 oz. silver in July, compared with 4,733,120 lb. refined lead and 265,620 oz. silver in July. The decrease was owing to changes necessitated by putting the mill in operation.

Butte & Superior in July produced 7,914,024 lb. of zinc in concentrates and 159,778 oz. silver, compared with 8,250,000 lb. zinc in concentrates and 160,000 oz. silver in June.

Cie du Boleo, Santa Rosalía, Baja California, produced 781,613 lb. copper in July, compared with 802,474 in June.

Cerro de Pasco produced 3,652,000 lb. copper in July, against 3,994,000 in June.

East Butte produced 1,537,880 lb. copper in July, compared with 1,396,140 in June.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Geological Survey Has Plans for Foreign Minerals Section

Domestic Producers Should Be Informed on Matters of Economic Significance Abroad

Since early in the war, the U. S. Geological Survey has entertained ambitious plans for its section of foreign minerals. During the war, this section did a large amount of work and from its data many economic conclusions with regard to mineral resources were reached. With the passing of the urgent war demand for this data, the difficulties of securing appropriations and personnel have prevented any great amount of work on the part of the foreign minerals section. The work has been kept going, however, and in the near future an important announcement as to the plans of the section is expected.

It is a very generally held belief that the United States has been particularly slow in acquainting itself with the mineral resources of other countries and in keeping abreast with their development. Had the United States been diligent in that regard during the last decade or two, it is pointed out, it would be in a better position now to compete in the world-wide quest for petroleum. At any rate, it is agreed that the mineral industries of this country are entitled to the help that the Government can extend by keeping them carefully informed on matters of economic importance in foreign countries which affect them. While some of the more highly organized companies may be in a position to keep sufficiently well-advised as to the foreign situation to conduct their operations in a most intelligent manner, it is certain that the smaller operators oftentimes do not become aware of important foreign developments having a bearing on their particular activities until losses have resulted. Many of these losses could have been prevented, had the information become available earlier.

Mining Conditions in Bolivia Discussed by Frank L. Hess

The mining industry in Bolivia has expanded to the point where labor supply has become a limiting factor of unusual seriousness. This is the opinion of Frank L. Hess, of the U. S. Geological Survey, who has just returned from an extended profesisonal visit to that tin-producing republic. Owing to the fact that much of Bolivia's mineral production comes from an altitude in excess of 14,000 ft. and very little of it from below 12,000 ft., the labor can be performed only by persons indigenous to those attitudes.

Because of the rigors of atmospheric conditions, the lack of fuel, proper housing and sufficient nourishment, the population on the high plateaus has been diminishing. Mr. Hess believes that the only solution to the problem is for the mining industry to make it possible for the Indians of that region to better their living conditions. The American companies and others of the more progressive mining concerns have been taking good care of their own employees for some years, but he believes that the welfare work must go further than that and include the entire populations of the upper plateaus.

There is promise of reducing the obstacles of lack of transportation and lack of fuel. The development of petroleum on the eastern side of the Andes in Bolivia, which now seems a certainty, will mean a near-by supply of fuel oil. The Guggenheims, in building a motor road from Eucaliptus, on the railroad, to Caracoles, have demonstrated that automobile transportation is possible. Water power is already being used successfully and important expansion is predicted by Mr. Hess.

The tin mining industry has continued its expansion which began with the war demand. A number of new properties are being opened, the district north of La Paz being the most active. The price of silver has given unprecedented stimulus to that industry. The whole of the famous Potosi hill is now being sampled and probably will be the scene of modern development on a very large scale.

The large amount of tungsten mining done during the war has developed beyond all question the value of the extensive tungsten deposits in Bolivia. When Mr. Hess left that country a few weeks ago, none of the tungsten properties was being operated, but he believes that some of them can be operated at present prices. He anticipates that Bolivia will be an important factor in the tungsten situation in the future.

Mr. Hess' geological studies in tin properties while in Bolivia lead him to think that it is becoming clearer and clearer that tin deposition in Bolivia is governed by the same processes as govern deposition of tin at other places, which is quite contrary to the opinion expressed by geologists who made earlier investigations of this problem.

Purchases of silver, under the Pittman Act, during the week ended Aug. 21, totalled 296,000 fine oz. This brings the total purchases under the act to 11,718,638 oz. The only purchases were made in the early days of the week, as it became apparent that the price of silver in the open market was going above $1 an ounce and no further offerings were made.

Tuscaloosa, Ala., Gets New Mine Experiment Station

Will Co-operate With University of Alabama—May Do Ferrous and By-product Work

Tuscaloosa, Ala., has been selected as the site for the U. S. Bureau of Mines experiment station that is to be established in the South. This station will co-operate with the University of Alabama at Tuscaloosa. The nature of the experimental work to be done remains to be decided. It was the intention originally to make this station distinctly a chemical one—that is, to confine its activities largely to the non-metals. There is such demand, however, for ferrous and byproduct work in the South that it is not improbable that this class of experimentation will be undertaken almost exclusively. It is suggested that as Tuscaloosa is near areas producing graphite, talc, clays and fertilizer materials, these subjects should be taken up at the new station.

The University of Alabama has offered laboratory, office and library facilities and will allow general co-operation in the work on the part of its technical staff. Tuscaloosa is 60 miles southwest of Birmingham.

Other contenders for the station were the University of North Carolina, at Chapel Hill, N. C.; Georgia School of Technology, at Atlanta; University of Tennessee, at Knoxville, and the city of Birmingham. Birmingham already has the office of the Bureau of Mines district engineer and a mine rescue station.

Bureau of Mines Must Have More Money

Otherwise Impossible To Make More Intensive Study of Metal-Mining Methods and Conditions

If the U. S. Bureau of Mines is to meet the increased demand for a more intensive study, from the economic viewpoint, of metal mining methods and conditions, appropriations for that purpose will have to be forthcoming. Officials of the bureau apparently are of the opinion that there can be no important curtailment of the existing program, certainly not enough to provide for substantial additional expenditures for a metal mining program if the total fund available is to remain the same. Roughly, the bureau's appropriation is divided among the following activities: Investigations as to the cause of mine explosions; the prevention of accidents in mines; technologic investigations pertinent to the mining industry; investigation of mineral fuels for the use of the United States; metallurgical investigations; petroleum work; min-

ing experiment work at stations and the operation of mine-rescue cars. The Government fuel yard is self-sustaining.

It is practically certain that the next Congress will be more generous in the matter of appropriations than was the last, so far as the Government's civil activities are concerned. With the pressure that is certain to come from the metal-mining sections of the country, it is regarded as highly probable that Congress will provide for an expansion of the Bureau of Mines' metal mining activities.

War Minerals Relief Awards

Awards recommended by the War Minerals Relief Commission, during the week ended Aug. 14, totalled $6,397.12, were as follows (the name of the claimant, the mineral, the amount recommended and its percentage relationship to the amount claimed are shown): Munitions Metals Co., chrome, $496.72, 8 per cent; G. C. Grimmett, chrome and manganese, $1,633.37, 41 per cent; C. G. Hughes, chrome, $1,052.40, 42 per cent; Moyle & Secco, chrome, $631.30, 95 per cent; Puterbaugh & Tuohy, chrome, $6,273.88, 78 per cent; J. S. Shepherd, manganese, $1,331.53, 86 per cent; A. H. Noyes, chrome, $971.80, 27 per cent. In the claim of Puterbaugh & Tuohy, the amount shown includes $280, which has been added to an award already reported during the week ended July 17.

The U. S. Bureau of Mines has agreed to furnish an exhibit at the convention of the American Mining Congress, which will be held this fall in Denver, Colo.

NEWS BY MINING DISTRICTS

MEXICO

Sonora

Las Chispas Property Examined

Las Chispas — Frank M. Manson, president of the Western Ore Purchasing Co., of Reno, Nev., recently inspected mining properties in the State of Sonora. One of the objects of his trip was to look into the desirability of establishing several samplers in Mexico and Arizona, but he took the opportunity to make a thorough examination of the property of the Las Chispas Extension Mining Co. in which he is interested. The mine is located in the Arizpe mining district, Sonora, 140 miles south of the border at Naco, and is the western extension of the Minas Pedrazzini holdings, the veins of which pass through it, according to the report of Frank W. Royer, who made an examination of both properties.

The country rock in which the productive veins of the district are found is a series of lava flows, consisting, in order, of rhyolite breccia, trachyte, another rhyolite breccia called locally "606" breccia, and then other trachytes. From the surface down to about 600 ft. depth the country rock consists of horizontally-bedded rhyolite breccia and tuffs, and it is in this formation that most of the large bonanza orebodies in the Minas Pedrazzini have been found. Immediately below the rhyolites and bedded tuffs is from 300 to 400 ft. of white trachyte. The vein continues through this formation but the orebodies found are, as a rule, not as big as those found in the rhyolite breccia. The vein continues into the "606" breccia and some bodies of ore are found. The lower trachyte has not been opened in any of the workings, so it is impossible to say if the veins continue into this formation.

The San Gotardo tunnel of the Pedrazzini Company opens up the Las Chispas vein at a depth of 600 ft. below the surface for a length of 4,000 ft. along its strike. The vein at this depth runs from the thickness of a knife blade up to 6 and 8 ft. wide.

The orebodies encountered in the Las Chispas vein, as related in Mr. Royer's report, are usually found by following quartz stringers which are scarcely more than seams in the rock; after following for several hundred feet, the vein opens up into an orebody. These stringers frequently contain no values whatever. The orebodies when opened up are from one to 6 and 8 ft. wide, and several hundred feet long, and as high as $3,500,000 is claimed to have been taken from some of the bodies first opened near the surface. The ore consists of quartz containing argentite, and the two antimonial silver sulphides polybasite and stephanite.

There has not been a great deal of development on the ground of the Las Chispas Extension company, but as it is said to have the extension of the Las Chispas vein, from which practically the entire production of the Pedrazzini company has been obtained, and as it is in the same ore-bearing formation, the outlook is thought to be encouraging. For a length of 200 ft. on Extension ground the Las Chispas vein is intersected by numerous cross veins and stringers, and it is expected that as depth is gained there shipping ore will be encountered. The vein was sampled, where exposed, by Mr. Royer and $88 values obtained from a 2-ft. streak and as high as $284 from a 2-in. streak. The samples were of soft, oxidized, leached material.

There is also a large vein, from two to 15 ft. wide, on Extension ground, along a contact of rhyolite breccia and andesite. Two 1-ft. samples from this vein gave returns of $23 and $60.80 per ton and while it probably will not be as productive as the Las Chispas vein, Mr. Royer has recommended its development.

Zacatecas

El Refugio mine, Pinos district, Zacatecas, 15 kilometers from the station of Sotol on the Aguascalientes-San Luis line, and adjoining the Benito Juarez property, is putting up a 50-ton mill and the owners expect to be operating by the end of the year. The district has been quiet for the last seven years on account of the depredation of small groups of bandits.

The Camp Bird (British) interests are doing a large amount of development work at Fresnillo, where they have taken over several large low-grade propositions, which have been idle for years owing to low price of silver and difficulties of handling the ores. A large cyanide plant is in course of construction for working the ores of the district and it is expected to be in operation by Dec. 1.

The old Mina Grande, on the outskirts of Zacatecas, has been taken under option and extensive development work is being done with the intention of erecting a crushing and cyanide plant in the near future. It is also understood that the Mina Grande people propose to build a railway between Salinas and the main line of the old Central railway at or near the city of Zacatecas for the purpose of avoiding the long haul for fuel oil that is at present being pulled from Salinas to Aguascalientes and back to Zacatecas.

The Mexican Mines Development Co. has taken a working option on the Noria property of Walter C. Palmer and has a considerable force of engineers on the ground making examinations. New York capital has also taken options on several less important properties in the same district (Sombrerete) and has its engineers there now making examinations and reports.

CHILE

At Chuquicamata the Chile Copper Co. is installing 35 fuel oil tanks, a new crushing plant, a dust-removal and recovery plant, 48-in. conveyors and feeders, three additional leaching vats and eight more solution sumps. This work is to be completed before next year. The output in June decreased, owing to the failure of the Union Oil Co. of California to deliver fuel oil according to contract. From 50,000 to 80,000 bbl. of fuel oil are used monthly at the company's power station at Tocopilla and 25,000 to 30,000 at Chuquicamata for the smelter and locomotives.

CANADA

British Columbia

Delta Copper To Be Drilled—Consolidated's Emma Mine To Resume

Hazleton—The Delta Copper Co.'s property, on Rocher de Boule Mountain, is to be diamond drilled. Tunneling that was being done has been found too slow and a drill will be installed as soon as possible. If results are satisfactory further tunneling will be done.

J. D. Galloway, resident engineer with headquarters at Hazleton, has been continuing Keystone drilling operations on the placer areas at Harper's Camp. This work was started last year but, for various reasons, could not be finished. An expert crew of men has been engaged by Mr. Galloway and operations have been underway for some weeks.

Trail—Four men were more or less seriously hurt recently in the copper refinery of the Consolidated Mining & Smelting Co. All were burned about the face and one may not recover his sight.

Ore shipments received at the Consolidated smelter during the week ended Aug. 7 are given in the following table:

Mine.	Location.	Gross tons
Canada Copper,	Greenwood	14
Index,	Zwicky	12
Josie,	Rossland	228
Mandy, Le Pas,	Man.	733
North Star,	Kimberley	120
Providence,	Greenwood	42
Velvet,	Velvet	34
Company mines		9,038
Total		10,221

Nelson—The Emma mine of the Consolidated Mining & Smelting Co. will resume operations immediately with 50 men. This property formerly shipped about six cars of ore a week but work ceased last year when production was discontinued at the Rossland mines. Now that the latter have been placed on a shipping basis Emma ore is required as flux. The ore is low-grade gold, silver and copper.

Vancouver—Conditions at Keno Hill, Mayo District, Yukon Territory, where the discovery of rich silver ore has been reported, are described by a miner recently returned from the North, who is quoted as saying:

"Preliminary prospecting has uncovered evidence of as many as nine separate leads of silver-galena shipping ore. The present known depth and length of these are such that shipping ore now in sight will require many years of considerable activity to mine.

"Taken from one of the leads on the plateau of Keno Hill is what the miners call the 'War Baby' silver galena nugget. It is one oblong piece of solid silver galena, similar in shape to a large potato, weight estimated to be 1,200 lb. From the same vein or ledge from which this piece came are four other nuggets or slabs. These are nearly solid silver galena and by comparison the weight of the smallest is easily 800 lb.

"On either side of these slabs and also below and above, the vein is in evidence, with manganese capping, carbonates and footwall.

"Owing to the surface character of some of the leads it has been possible to develop with comparatively little effort to a point where ore can be shipped. In places one man can pick down or mine a quarter of a ton of shipping ore per working day."

It is stated by the same individual that the holdings of the Yukon Silver Lead Mining Co. were located and partially developed before the discovery of the Keno Hill properties. The former are situated on Mount Haldane or Lookout Mountain and are in direct line with Keno Hill and the Silver King, from one pocket of which silver is said to have been taken valued at $500,000. Much development has been done on Lookout Mountain, tunnels and shafts having been driven aggregating 1,200 ft. It is stated that the vein has been followed for 400 ft. perpendicularly, disclosing good shipping ore. Development on such properties as the Silver King, Mount Rambler and others in the section, as well as in the Twelve Mile area, should prove the extent of the area of the silver-lead orebodies in the Yukon.

Ontario

Dome Shareholders Asked to Ratify Purchase of Dome Extension—Conditions at Cobalt Improved

Porcupine—A diamond drill hole put down recently by Hollinger to test geological conditions cut ore at a depth of 2,400 ft. It is understood that an English syndicate has acquired a number of claims lying west of the Hollinger. These are in a sand plain and are covered by about 70 ft. of overburden. About 20,000 ft. of diamond drilling will be done in an effort to locate the contacts and the extension of the Hollinger orebodies.

A special shareholders' meeting of the Dome has been called for Sept. 4 to ratify the purchase of the Dome Extension property by the issue of 76,000 shares of Dome. The purchase has received the unanimous approval of the directors.

The Davidson, which is now closed, is understood to have received sufficient English money, through the sale of stock, to permit the resumption of operations on an extensive scale.

On Sept. 7 a special shareholders meeting of the Vipond will be held for the purpose of ratifying the proposal to sell a block of treasury shares to a syndicate headed by H. B. Wills. The mine will be pumped out and the shaft deepened from the 600 to 900-ft. level.

The supply of labor in the camp, though still below the demand, is increasing. An influx of British miners is anticipated owing to the dullness of the English mining industry, and it is stated that the Hollinger Consolidated has already arranged to take on fifty English mine workers.

Kirkland Lake—The Granby Kirkland has uncovered six veins on the Bain. Telluride is said to have been found in a vein 15 ft. wide.

Boston Creek—The Miller Independence is offering 40,000 shares of treasury stock to present shareholders at $1 per share. Development work latterly has consisted chiefly in cross-cutting and drifting on the 500 level. The main cross cut is in 300 ft., and is believed to be within 70 ft. of the gold telluride deposit opened in an incline.

Gowganda—The mines of this district with the exception of the Miller Lake-O'Brien, the Castle and a few others are inactive, operations having been suspended in the majority of cases owing to the excessive cost of labor and supplies and the drop in the price of silver.

The management of the Big Four mine has decided to employ oil-burning engines to overcome the fuel difficulty. A shaft is down 40 ft. and has cut ore.

Cobalt—In Cobalt, the rising price of silver has caused a more optimistic feeling, and this, together with a better labor supply, is responsible for increased activity throughout the district. A certain amount of foreign labor is coming in and despite the heavy drain of men for the harvesting in the West, the supply for the mines is sufficient.

The Crown Reserve will do 5,000 ft. of diamond drilling to locate the diabase sill definitely.

The Kerr Lake is now treating dump ore in the Dominion Reduction mill and results are understood to be better than had been estimated.

The Peterson Lake has struck three narrow veins in cross cutting on the 200 level. A large orebody is being blocked out.

The Provincial, situated in the Gillies timber limit, has opened up a high-grade vein on the 200 level for 50 ft. Raises show that the vein extends upwards for at least 50 ft.

The July ore shipments over the T. & N. O. Ry. were as follows: Coniagas, 64; Dom. Reduction, 65; Hudson Bay, 30; La Rose, 89; Mining Corporation, 64; McKinley-Darragh, 42; Northern Customs, 48; Nipissing, 447; O'Brien, 97; and Temiskaming, 41; total 988. This was consigned as follows: Deloro S. & R., 763 tons; Coniagas Reduction Co., 33 tons; A. S. & R., Perth Amboy plant, 42; A. S. & R., Pueblo plant 150 tons.

Manitoba

Gold Pan and Pan Extension Form Agreement

Rice Lake—The Gold Pan and Pan Extension Companies have come to an agreement under which the Pan Extension will supply power to the Gold Pan. J. A. Borthwick, superintendent of the Pan Extension, will have charge of both mines, which will both work double shifts. The shaft of the Pan Extension will be put down from its present depth of 115 ft. to the 500-ft. level.

NORWAY

Glomfjord Smelter To Start Zinc Refining on German Shell Cases

Glomfjord—The new hydro-electric plant is ready to furnish 50,000 hp. and the capacity is being increased. The smelter company, which has a capital of 12,000,000 kroner, will start operations next month with zinc refining. The zinc consists of shell cases purchased from Germany, of which the company has several shiploads. The Germans had to revert to zinc for their cases when the supply of copper ran out. Later the smelter will treat zinc ore purchased from Sweden. The company has leased about 50,000 hp. from the state power station, which is ready at any time to furnish it.

It has been decided to operate the Dunderland mines again in about a year's time. A new method of dealing with the ore has been experimentally tried, but high freights and coal prices have necessitated a waiting period before recommencing work. The company has expended 40,000,000 kroner in construction and mining, including the 22-kilometer Dunderland railway. Since the mines closed down in 1908 a number of men have been employed in maintenance and repair work in connection with the buildings and equipment.

MINNESOTA

Cuyuna Range

North Range Iron Co. Leases Onondaga Co.'s Land

Ironton—The North Range Iron Co., controlled by R. M. Adams, has taken a lease of Lots 1, 2 and 5 of Section 4—46—29, from the Onondaga Iron Co., of Duluth, controlled by G. G. Hartley. The property will in turn become part of the Marquette Ore Co.'s operations. The land just leased fronts on Mahnomen Lake, and will be valuable for water supply for hydraulic stripping and for wastage of tailings from the washing plant now being erected at the Maroco mine of the Marquette company. The shaft at the Maroco has reached a depth of 210 ft. The property will be stripped hydraulically.

The Cuyuna-Duluth mine has completed installation of a triplex electric pump on the new 340-ft. level. The operators are planning to use motors for haulage on the new main level.

Crosby—The Croft mine will sink two new shafts for drainage and handling of timber purposes. One shaft, 6 ft. by 9 ft., has been started at a point about 1,000 ft. east of the main shaft.

Mesabi Range

Shipments Increasing from Hibbing District—Thirty-Five Drill Holes on Stubler Project Find Ore

Hibbing—Shipments from this district, although not yet up to capacity, have increased considerably during the last two weeks. The Oliver Iron Mining Co. is shipping from 1,200 to 1,500 cars daily from the Hull-Rust, Morris, Sellers, Kerr, Sweeny, and Philbin mines. Screening is in progress at the Morris and Webb mines and at the latter the screening plant product is also being washed.

Winston-Deare have finished the drag-line excavator work at the Scranton and are tearing the machine down for shipment to the Sagamore pit on the Cuyuna Range where they now have a similar machine in operation.

Buhl—The Great Northern Power Co. is completing a central power-distributing station to serve the Wabigon, Frantz and Thorne properties of the Hanna Ore Mining Co. The Wabigon will be the scene of the first electrical shovel operation on the Mesabi Range and it is expected that stripping will start early this fall.

The forty-fifth hole has been completed at the Stubler exploration project and it is reported that thirty-five of the holes have found ore. It is now proposed to sink a small shaft for the purpose of exploratory drifting.

Mountain Iron—The U. S. Bureau of Mines car is at Brunt mine of the Hanna Ore Mining Co. where it will remain four or five days, later going to Hibbing where it will be stationed at the Leetonia mine.

MICHIGAN

Marquette Range

Cliffs Shaft Change House Burned—Diamond Drilling Standard Property

Republic—Cole & McDonald have two diamond drills working on the old Standard property, but no information has been given out regarding those who are back of the project. Considerable work was done in this vicinity several years back, but no mines of importance were ever opened. Some ore was found, but not in sufficient quantity.

Ishpeming—On August 17 a part of the change house at the Cliffs Shaft mine was destroyed by fire. Many of the several hundred miners who make use of the building lost their underground clothes. The building is to be rebuilt immediately.

Menominee Range

Crystal Falls—The railroad serving the Odgers was tied up recently for a time because of a cave in of the surface at the Bristol mine. The St. Paul road is not using the North Western tracks to the mine and will probably not be able to use them for the remainder of the season. The cave was expected at the Bristol and caused no interruption of mining work.

ALABAMA

Iron Ore and Lands in Demand by Interests Outside Birmingham District

Birmingham—Representatives of interests outside the Birmingham district have been examining certain iron-ore lands in Alabama. Most of the iron land in the state is already under lease to or owned by companies using the output. There are a few independent ore mining companies which have no trouble in selling their output. When the Gulf States Steel Co. gets its deep mining project at the Shannon mines under way, it will be unnecessary for it to look to independent companies for any of its needs. At present the Gulf States company is getting some ore from the Crudup mines near Gadsden. The owners of the Crudup property are said to be not in the least disturbed at the prospect of losing a customer, as there are almost daily inquiries for ore and various propositions for taking over the mines altogether have been heard of lately. The property has been recently appraised, inquiries being made looking to the purchase of the Trussville blast furnace, which would make it necessary to secure ore from the Crudup mines.

Development of brown ore in the vicinity of Russellville, in northwestern Alabama, is being pushed, the Sloss-Sheffield Steel & Iron Co., the Sheffield Coal & Iron Co., the Alabama Fuel & Iron Co. and others being operated steadily in this section. Brown ores in the vicinity of Woodstock, Ala., property of the Republic Iron & Steel Co., are also under development.

Ashland—The new plant of the Dixie Consolidated Graphite Co. is nearing completion. It will have a capacity of 400 tons of ore per day.

ARIZONA

Van Dyke Shaft Bottomed — Jerome Verde Property Closed Down—U.V.X. Commissary for Jerome

Ajo—Two 25-ton Trent cyanide machines have been purchased by A. W. Bramwell, to recover values lost in amalgamating silver-gold ores of a Gunsight property operated by him.

Globe—The Van Dyke Copper Co.'s shaft has been bottomed at 1,692 ft. and levels will be opened at 1,215 and 1,550 ft. The shaft cut ore on the dip at 1,180 ft. which continued for 40 ft.

Tombstone—The Solstice M. & M. Co. has made final payment to L. F. Winters of the purchase price of its local holdings, in which it is claimed that $120,000 worth of ore has been blocked out. Plans are being made for a 50-ton mill, with cyanide equipment and for a hoist and compressor. The ore is said to run $18 a ton.

Bisbee—About three-fourths of the overburden of the Sacramento Hill has now been removed by the steam shovels that have been operating on the hill benches for several years past, and it is expected that the copper-bearing schist will be exposed for mining early in the new year, about the same time that the new concentrator is completed. Although an enormous tonnage of low-grade disseminated schist will be available at Sacramento Hill, more will come to the mill from the Copper Queen stopes, where the ore has already been developed, though passed by as too poor for profitable smelting. The

Sacramento Hill operations will extend up Mule Pass almost into the city of Bisbee and will radically change the face of nature in their locality.

Jerome—Samples taken across the 5-ft. face of the Shea tunnel are reported to average 15.6 per cent copper, 15 oz. silver, 1 04 oz. gold, or a total of $88.30 a ton. The face of the tunnel is in chalcopyrite.

U. V. Extension has bought a lot in Jerome and is expected to build a commissary on it such as the one at Clemenceau.

Joe Cavanaugh and Harold Caldwell, of Jerome, are reported to be preparing to erect a flotation plant on the Blue John property at Walker. They are shipping some ore.

The Jerome Verde property has been closed down indefinitely and the pumps pulled. Lack of funds is given as the reason.

Turkey — The Howard Copper Co. states that it is not affiliated with the Howard Silver Mining Co., in the Black Canyon district, as reported in the issue of July 31.

Poland—Only the ties and rails of the abandoned Poland railroad are to be removed. Under an agreement with Yavapai County the road bed and bridges will be left intact and will be used for making a county road, over which ore may be trucked to the nearest railway shipping point.

Bouse—Plans have been made for development of water power on Bill Williams Fork by R. M. Stene and associates, as an annex to the operations of the Stene Consolidated Copper Co., which has a large acreage of low-grade carbonate ores in the southeastern corner of Mohave County. Plans have been filed with the State Water Commissioner for a dam 144 ft. long, its crest to be 110 ft. above the river bed, and for a concrete conduit leading to irrigable lands situated near Bouse.

Greaterville — The Liberty Silver Mining Co., operating the Saint Louis group, has its main shaft down 200 ft on a vein that shows 3 ft. of silver-leaf ore, with copper coming in on the footwall.

Tucson—S. W. Purcell has bought a fluorspar deposit in the Sierritas from the estate of Gus Holstein.

NEW MEXICO

Co-operative Ships High Grade—Unwatering Silver King Near Central

Lordsburg—The Bonney Consolidated Copper Co. is working about 40 men on outside development work with good results. Several new strikes of high-grade surface ores carrying copper and silver have been made. A strong vein of silver-lead ore opened on the east end of the property will be further developed.

The main shaft of Calumet & Arizona's 85 mine is reported to have reached the 900-ft. level.

The Co-operative mine shipped a car of ore, half of it high grade, to the El Paso smelter on Aug. 12.

The Octo is pushing work on the new drift on the 300-ft. level. Good carbonate copper ore was struck in cutting the station. About thirty men are working. Fred C. Semmek is superintendent.

Silver City—T. C. McSherry and eastern associates have started operations at the Silver King near Central. At present the mine is being unwatered. The property consists of five claims and has been worked occasionally since the 80's. Development consists of a main shaft, 117 ft. deep, and several hundred feet of drifts and cross-cuts.

The Silver Spot mine is continuing to open good ore. No. 2 shaft has been sunk to 73 ft. and the silver-bearing vein has opened to 10 inches.

is under construction. The foundations are completed, and some of the machinery is being installed. The process to be used will require the installation of flotation equipment.

Mayday—Curtet & Moigg, lessees on the Southern Boy, have completed their cross cut, having penetrated the ore-body after eight-months' work. The vein is 1 ft. wide and is said to run in gold.

The Mayday Leasing Co. continues operations on the Mayday dumps. Two cars have been shipped to the Durango smelter. The screenings run $16 to $28.50, with some crude assaying as high as $70 per ton in gold and silver.

The Jumbo continues shipping from the 800-oz. silver vein recently found in the raise. Another raise is being

LOOKING NORTH OVER PLANT OF UNITED VERDE EXTENSION MINING CO., JEROME, ARIZ. DOUGLAS RESIDENCE AT RIGHT

COLORADO

Valley View Concentrator Completed—North Boulder Creek Co. Erecting Mill

San Bernardo—The new 100-ton concentrator of the Valley View Leasing & Mining Co. has been completed and test mill runs are being made for the purpose of adjusting the machinery. Walter L. Reid, of Telluride, is designer of the plant, and Harry Doyle was engineer in charge of construction. The mill will treat ore from the San Bernardo mine. The milling process includes ball mill crushing and oil flotation.

Telluride—Shipments of concentrates from Telluride for July were as follows: Tomboy, 60 cars; Smuggler-Union, 35 cars; total, 95 cars.

Ophir—Development of a lease on the Favorite mine under the direction of Gideon Baril has opened payable shipping ore. A carload has been shipped to the smelter at Durango.

Boulder—Shaft sinking is under way on the Blue Bird mine, of the North Boulder Creek Mines Co. A new mill

driven to explore the fissure vein and lime stratum at contact.

W. A. Becker, manager of the Little La Plata and Boren Gulch, is having a compressor installed at the latter property. Mine operation will then be resumed.

The cross cut at the Little La Plata property, which has been pushed continuously since last winter, has not proved as beneficial as was expected. Part of the force employed on this has been put to work on the vein at surface, from where lessees have made shipments of ore.

R. E. Hutchinson, of Durango, owner of the Puzzle in La Plata Canon, is to begin work soon on the property. The 700-ft. tunnel will be extended to cut the Southern Boy vein. Hutchinson is owner of the Southern Boy, which is being worked by lessees who are mining some good ore from a small streak.

Work of installing a 12-mile telephone line from Mayday to La Plata has been completed. This line was built by the operators in La Plata Canon, and will be connected with the Cumberland, Allard and Ten Broeck, as well as with the postoffice at La Plata.

MONTANA

Work Stopped at Mt. Washington Mine in Wickes District—Planned To Reopen Comet

Butte—Drifting upon the orebody recently opened by Anaconda at a depth of 3,800 ft. in the Stewart shaft shows a shoot 10 ft. wide averaging 12 per cent copper. Portions of the orebody will run up to 20 per cent. Anaconda has opened an orebody said to be 80 ft. wide in the Nettie mine that carries good milling values in silver, lead, zinc and gold, together with considerable first class ore. The July production of Anaconda was 1,000,000 lb. of copper less than in June. Operations are curtailed over 50 per cent.

Butte & Superior's Black Rock mine in July produced 31,702 tons of ore from which 7,348 tons of concentrates was made, as compared with 34,200 and 7,800 respectively the preceding month. The output of zinc in concentrates was 7,914,024 lb. with the silver yield 159,778 oz. as against 8,250,000 lb. zinc and 160,000 oz. silver in June. Mill recovery in July was 97 per cent. This is somewhat greater (about 3 per cent) than in recent months owing to a general mill cleanup that was made, in the course of which small lots of ore more amenable to treatment were handled.

The North Butte company's Granite Mountain mine in July produced 1,555,079 lb. of copper, 65,324.92 oz. of silver and 98.88 oz. of gold as compared with 1,616,822 lb. copper, 67,534.45 oz. silver and 97.65 oz. gold in June. A feature of development work at present at the Granite Mountain is the driving for the Edith May vein on the 3,600-ft. level to reach points under the 3,400 and the 3,200-ft. levels, where a high-grade showing of ore in substantial tonnage is in evidence.

Shipments from Tuolumne Copper's Main Range mine continue at a rate of from 100 to 150 tons daily. A good tonnage is reported either in sight or indicated. Arrangements are being made with a view of starting to sink the Main Range shaft from the 1,200 to the 2,000-ft. level.

The ore showing on the 2,700-ft. level of the Colorado mine is said to be the best in the property's history as regards the tonnage of high grade indicated. The output is being held down to 200 tons daily with the grade ranging from 7 to 8 per cent copper and 6 to 8 oz. silver.

Sinking of the Plutus shaft has reached a depth of 300 ft., with the 400 level as the objective, at which point crosscutting for the Norwich vein will be started.

Shipments from the Crystal Copper Co.'s Goldsmith mine are continuing regularly with the 600-ft. level showing well.

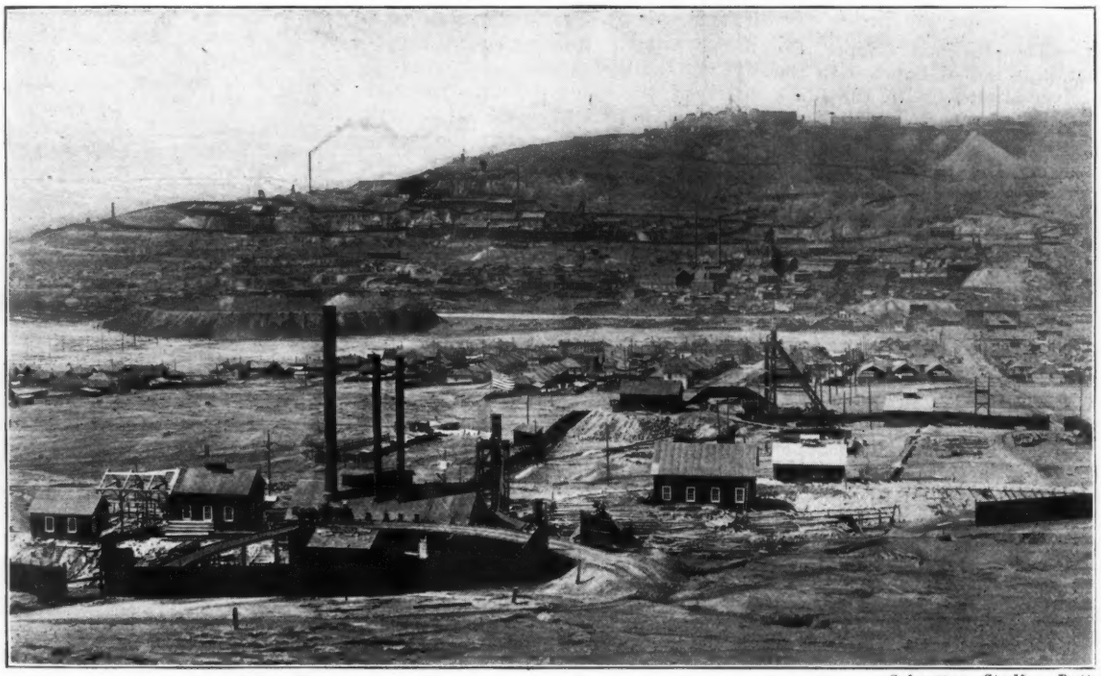
East Butte plans to resume drifting on a new orebody on the 1,800-ft. level opened several months ago. The flow of water has been so heavy that it has been almost impossible to keep men at work in the face, but the situation is improving.

The Barnes-King Development Co.'s North Moccasin mine in Fergus County produced $1,350 in gold bullion in July and the Shannon, in the Marysville district, produced $24,600. The Piegan-Gloster mine was closed during the month, its operations last year having cost the company about $80,000.

Champion District—Ten cars of ore have been shipped by Butte Jardine from the Champion mine since the company took over the operation of the property. The ore showing in the tunnel level has been disclosed for a distance of 400 ft., with the milling ore as much as 8 ft. wide, and with high-grade ore about 18 in. wide. This is at a depth of 550 ft. The winze from this tunnel is about 20 ft. deep and shows a continuation of the present ore. Milling ore is averaging about 18 oz. of silver and $1.20 gold.

Wickes District—Operations at the Mount Washington property have been suspended, apparently awaiting the construction of a mill. A large tonnage of first class ore has been shipped from the upper levels.

Comet District—The Montana Consolidated is planning to resume operations at the Comet mine, an old time silver producer. The presence of considerable zinc in years past served to prevent profitable treatment.



Schoettner Studios, Butte

PLANT OF TUOLUMNE COPPER CO.'S BUTTE MAIN RANGE MINE, BUTTE

Lump Gulch District—Opening of a high-grade body of silver ore is reported at the Free Coinage mine of the Amalgamated Silver Mines.

Regular shipments of silver ore of good grade are being made by Liverpool Mines, the orebody on the 700-ft. level showing an improvement with drifting.

The ore continues to show well on the 100-ft. level of the Vera Cruz property.

IDAHO

Sandpoint—The Ten of Diamonds and Lone Star claims have been sold by J. W. Lloyd to the Trail Mining Co., of Sandpoint. The property is on Pine Creek in the Priest River district.

Wallace—The Pine Creek R.R. will be extended to the forks of the creek and about four miles up the west fork, by Fred Herrick, of the Milwaukee Lumber Co.

UTAH

Chief Consolidated Finds New Ore Near Plutus Ground—Judge M. & S. Commissary in Operation

Eureka—Low-grade ore with streaks of higher grade has been opened in the Chief Consolidated, promising a new ore zone, as the find, made on the 1,800 level, about 1,200 ft. from the new shaft, is 1,300 ft. to the east of known ore deposits. This new development is of interest in prospecting the Plutus holdings of the company, as the new ore zone, if developed, would make directly through this ground. Accompanying the list dividend checks, paid Aug. 3 and amounting to $88,423, was a statement presaging a possible reduction or omission of the dividend for the coming quarter, owing to the drop in the price of silver, which had left the quarter practically without net earnings. The management expressed itself as expecting to be able to make adjustments such as would bring about a restoration of earnings, but deemed it best to issue the precautionary note.

Shipments from the Tintic district amounted to 150 cars the week ended Aug. 7 as compared with 140 cars the week preceding.

The Griggs-Huish mill has been warmed up, and is reported to have made a good saving on ore from the May Day dumps. Connections are being made with the Yankee workings, so that the mill may be able to handle low-grade ore accumulated here. The Yankee has never before made any attempt to utilize its low-grade ores.

It is reported that some of the freight cars handling ores from the Tintic district may be diverted to the coal fields, which might cause a car shortage for the metal mines. Work is going on as usual at the Eureka Bullion following the brief shut-down for repairs.

At the Bullion Beck seven cars of ore have been shipped since the retimbering of the shaft. More leases have been given. There is considerable ore left in old workings here.

Salt Lake City—The U. S. Geological Survey is making preparations to continue the survey of the mines of the Cottonwood district. This survey, begun last year, will be resumed in American Fork Cañon, also.

Park City—The store of Judge Mining & Smelting Co., furnishing supplies to employees at cost, is now in operation.

The Park-Utah shipped a car of ore the week ended Aug. 7. The company has secured enough miners for one full shift, and as soon as more men are available, will put on two shifts.

Shipments from Park City for the week ended Aug. 7 were 2,328 tons of ore and concentrates as compared with 1,901 tons the week preceding. Shippers were: Judge Mining & Smelting, 721 tons; Judge Mining & Smelting (spelter), 20 tons; Ontario Silver, 540 tons; Silver King Coalition, 524 tons; Daly West, 339 tons; Park-Utah, 64 tons; and Naildriver, 120 tons.

CALIFORNIA

Extension of Walker Orebody Cut by Diamond Drills—Unwatering of Fremont Progressing

Drytown—Dewatering of the Fremont near Drytown is advancing at the rate of 25 ft. daily. It will be possible to resume development soon. The Gover shaft has been put in good shape. The new owners are planning extensive development.

Amador City—The new orebody recently found on the 2,800 level of the Bunker Hill is reported to be developing satisfactorily. The deposit is being opened by drifts and cross cuts and shows much ribbon quartz. The money derived from the new assessment, delinquent August 24, will be used in seeking extensions of the new ledge for development.

Portola—Diamond drilling has opened extensions of the Walker copper lode 2,100 ft. north of the Walker mine. The first drill holes cut the deposit 1,500 ft. north of the Walker group, and a second series of holes tapped the lode 500 ft. farther north. The discovery has stirred much interest throughout the Plumas copper field. In the Walker mine proper the main orebody has been opened to a depth of 300 ft. and shows a width of 18 to 20 ft. on the third level, with the ore sampling 4 per cent copper and $2.20 gold and silver per ton.

Preparations are being completed for extensive operation of the Five Bears, Tri-Metallic, Copper Cliff and Eagle Groups.

The Five Bears claims have passed into the hands of a syndicate of Arizona copper men, and the Tri-Metallic is controlled by San Francisco interests. Nevada capital has acquired the Copper Cliff, and Seattle interests have taken over the Eagle.

The Gruss mill is now in place and when oil is obtained the new plant will be put in commission. Large reserves of excellent ore are awaiting treatment at the present time.

Prospecting of the Poor Boy with drills is proceeding preliminary to driving a 3,000-foot tunnel. The present work is designed to establish the depth of the bedrock and probable dimensions of the channel.

Keeler—A drift has been advanced 75 ft. in an oreshoot at 100-ft. depth in a winze from the Morning Glory tunnel of the Estelle Mining Co., whose property adjoins the Cerro Gordo mine. A raise has been put up 25 ft., at which point the ore is 15 ft. wide. This new oreshoot, which is from 9 to 16 feet in width, shows higher lead values than other shoots, the ore averaging about $45 per ton in gold, silver and lead. It also carries some copper, bismuth and antimony. Shipment is by means of a tramway, 7,000 ft. long, to the Cerro Gordo road and thence by trucks four miles to Keeler. It is planned to ship about 20 tons per day but truck trouble has been experienced, which is apt to delay the program.

NEVADA

Rochester Silver's Report Out—Holmquist Mine Near Ely Shipping Manganese Ore

Rochester—The Rochester Silver Corporation has just released the report signed by F. M. Manson, chairman of the executive committee, and C. D. Kaeding, consulting engineer, for the period from January 1, to June 30, 1920, together with a statement of earnings, and an outline of conditions existing at this date. The report shows a profit of $151,614.77 for the six months but attention is called to conditions which will preclude the probability of making equal profits during the current six months—among them being the drop in silver and the cessation of milling operations owing to lack of power.

In all 26,570 tons was milled averaging 12.91 oz. silver and 0.153 oz. gold per ton. The bullion recovery per ton milled was $14.94. Ninety-two per cent of the gold and 81.3 per cent of the silver were recovered. The value of the bullion sold was $396,955.76. Five and four-tenths tons of ore was milled per foot of development.

The total operating expenses were at the rate of $9.23 per ton, of which $2.45 is charged to stoping, $1.80 to development, and $2.81 to milling and refining. Of the net operating profit of $151,614.77 there was credited to depletion and depreciation reserve $36,145.01 and $115,469.76 as net surplus to balance sheet.

Mr. Kaeding calls attention to the unusually large amount of development for a mine producing only 150 tons daily—the footage being 4,871—but adds that "the results of this work have not been nearly so favorable as during the last quarter of 1919." He estimates that there is not more than six months' reserve of ore in the mine, much that was considered ore when silver was selling at $1.25 or better being now below pay.

The balance sheet shows an excess of current assets over current liabilities of $269,991.19—most of which is in the form of cash, bullion or working for mines and mill.

Goldfield—The Deep Mines Co. has started a small force at work preliminary to sinking an old shaft on the southern end of the Combination claim, east of the Atlanta ground. The present shaft has two compartments and is down nearly 600 ft. It is planned to enlarge to four compartments and sink to the 3,000 level.

Spruce Monarch—From 90 to 100 tons of ore is now going out from the Spruce Monarch mine daily, some going to Tobar on the Western Pacific and some to Currie on the Nevada Northern, but all going to Utah smelters. One caterpillar, hauling from 25 to 30 tons of ore, is said to make the round trip to Tobar every 24 hours.

Sulphur—A. J. Crowley, former superintendent of the Nevada Sulphur Mining Co., has interested the Red

River Lumber Co. in the property and it has advanced $50,000 for necessary additional machinery and improvements. He will put in an electric lighting plant, and has ordered a Chicago Pneumatic compressor, Cochise drills, ore cars, and other equipment from the Western Machinery & Engineering Co., of Reno. The Red River is one of the largest lumber companies and is owned by Walker Brothers, of Minneapolis.

Reno—Work will begin at once on a 1½-mile transmission line to the Black Panther mine, three miles north of Reno. It is planned to put in an electric hoist and pump. The shaft is down 190 ft. and shows some good copper ore. Al Marsal is manager.

The mill of the Standard Metals, 12 miles north of Reno, is shut down and only development work is being carried on at the mine.

Ely—A report issued from the office of the White Pine County assessor shows that the gross yield from the mines of White Pine County for the quarter ended July 31 amounted to 794,030 tons of ore of a total value of $2,663,576.22.

Three hundred tons of manganese ore per month is to be shipped to Chicago from the Holmquist mine near Ely, under a contract recently entered into by Schultz, Clark & Hamilton, lessees. The first shipment went forward recently.

Death Valley—The Standard Oil Co. has purchased a deposit of sandstone in Death Valley, north of the deposits owned by the Associated Oil Co. according to John T. Overbury who is interested in that section.

Carlin—The Tri-O-Lite Products Co. expects to start the mill soon that was recently completed for handling the kieselguhr deposits near Carlin.

Schellbourne—Two trucks have been hauling ore from the old Siegel mines at Schellbourne, in Spring Valley, in eastern Nevada, but bad roads resulting from recent storms have delayed shipments.

Mina—Milling ore and what is believed to be the downward extension of the hanging-wall orebody developed on the 4th, 5th and 6th levels of the Simon Silver-Lead mine has been struck in a raise 50 ft. above the 7th level. It has been driven on for a width of 17 ft. with no wall in sight. Assays show it to be of better grade than the average milling ore on the upper levels. Crosscutting has been started to the northwest in which direction the orebody pitches and it is expected that it will be cut within 40 ft. Surveying for the mill site is under way and grading will begin in the near future. An initial unit of 100-125 tons capacity will be built. Lloyd C. White, of Burch, Hershey & White, San Francisco, is designing the mill.

New Pass—The mill on the gold property at New Pass, 25 miles across the Reese River valley from Austin, is being dismantled by W. C. Pitt, controlling owner. The quantity and grade of ore were insufficient.

Boyd Siding—I. R. Landis, of Los Angeles, has purchased some kaolin claims near Boyd Siding, on the Salt Lake Railroad, from N. E. Williams and T. J. Parker. The price is said to have been $30,000, with $5,000 paid down. Landis is said to have contracted to sell the output to the Empire China Co., Los Angeles. The deal was made on the report of John C. Charles, of Hollywood, Cal.

Jackrabbit District—The Bay State Mining & Leasing Co. is shipping high-grade silver, lead and copper ore from the Ida May property in this district. Arthur Murphy is president and manager.

JOPLIN-MIAMI DISTRICT

Oklahoma-Kansas-Missouri

Rakowsky Sinking on Blue Bird Lease —Anna Beaver Using First Surface "Hopper" at Tar River

Webb City, Mo.—The Webb City & Carterville Development Co. reports finding lead in two drill holes put down on "Sucker Flats," southeast of Webb City, and will sink a shaft on the lease at once.

Baxter Springs, Kan.—Miller & Holcomb are driving a drift on the 102-ft. level of the Lucky Joe property at Sunnyside to a drill hole put down some time ago. A Cornish lift pump is handling the water. The mill at this mine was sold to the Wolverine Co. some months ago and has been moved to the Portis land, west of Quapaw, where it has been re-erected and is now in operation. I. M. Holcomb, manager of M. & H. Co., plans to erect a small custom mill at old Lucky Joe site.

George Meese, of Joplin, is preparing to sink a shaft on the Ebbenstein land, a short distance west of the Chanute property.

Victor Rakowsky and associates are putting down a shaft on what is to be known as the Blue Bird lease, immediately north of the Chanute.

Tar River, Okla.—The Anna Beaver Mining Co. is successfully handling ore from its No. 3 mine by a surface railroad and a surface hopper at No. 2 mill. This is the first surface hopper in the field. About 75 tons of ore is being hoisted per hour and more could be handled by the new equipment if the hoisting capacity were greater. The output of the mine is now largely lead, owing to the uncovering of rich lead-bearing ground at No. 1 mine.

WASHINGTON

Valley—The American Minerals Production Co. is shipping 6,000 tons of crude magnesite a month, according to H. F. Wierum, general manager. "The company has a kiln designed for making a superior calcined product for flooring and use in the stucco trades," said Mr. Weirum. "It was designed after about $20,000 had been expended in determining how to design it. About 80 per cent of the construction on the plant has been completed. The remainder awaits the receipt of machinery ordered in the East and shipped in May. This machine will produce a calcined product that will make stucco for floors superior to any produced."

CHRONOLOGY OF MINING
JULY, 1920

July 1.—Experiment station of U. S. Bureau of Mines, forced to move from Golden, Col., by action of Colorado School of Mines, relocated at Reno, Nev.—British Columbia's Placer Mining Act amendments went into effect.—Federal Mining & Smelting Co., Wallace, Idaho, insured lives of employees for benefit of their dependents.

July 4.—Drilling contest at Idaho Springs, Col.

July 6.—Minerals Separation, Ltd., hearings resumed in San Francisco, Cal., continued to July 10.

July 9.—Metals Extraction Corporation's baghouse at Joplin, Mo., damaged by fire.

July 10.—Northern Minnesota Ore Co. closed down Northland mine and pulled pumps.—Ferro mine buildings and equipment near Trommald, Minn., sold by sheriff.

July 13.—Minerals Separation, Ltd.'s, petition to hold Miami Copper Co. in contempt dismissed by Judge Morris, U. S. District Court, Wilmington, Del. —Minerals Separation, Ltd., hearings adjourned from San Francisco, resumed at Salt Lake City, Utah.

July 14.—United Verde Copper Co.'s old coke bins and quantity of fuel oil burned.

July 15.—Philippine Islands Mint at Manila began operations.

July 18.—Central Eureka shaft at Sutter Creek, Cal., completed.—Lightning and fire destroyed Omaha Mining Co.'s compressor building at Wallace, Idaho.

July 19.—Northwest Magnesite Co. dividends to amount of $500,000 involved in suit brought by R. S. Talbot, Spokane, Wash., against William H. Crocker, San Francisco, Cal.

July 20.—International Mining Convention held for third time at Nelson, B. C.—Safety-first contest started in Butte, Mont., district, to end Aug. 21. —Mexican decree concerning delinquent mining taxes published in Diario Oficial.

July 23.—American Mining Congress' Utah Chapter discussed with H. N. Lawrie plan for premium of $10 per ounce on newly mined gold.

July 26—New York State purchased 2.25 gm. of radium for use of state research at Buffalo, N. Y.

July 27.—Striking mine and oil workers of Mexico return to work in large numbers at request of President. —American Smelting & Refining Co.'s sampling mill No. 4 at Murray, Utah, burned down.—Vipond-North-Thompson (Porcupine, Ont.) shareholders ratified sale of 600,000 shares to an English syndicate.

THE MARKET REPORT

Daily Prices of Metals in New York

Aug.	Copper	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
19	18.25@18.35	43.25	47.00@47.75	8.75@9.00	8.85	7.90@7.95
20	18.25	43.00@43.50	46.75@47.25	8.50@9.00	8.75	7.95@8.00
21	18.10@18.25	43.00@43.50	46.75@47.25	8.50@9.00	8.75	8.00@8.05
23	18.10@18.25	42.50@43.50	46.50@46.75	8.25@9 00	8.50@8.75	8.00@8.05
24	18.10@18.25	41.75@42.75	45.50@45.75	8.25@9 00	8.50@8.75	7.95@8.00
25	18.10@18.25	41.75@42.75	45.50@45.75	8.25@9.00	8.50@8.75	7.95@8.00

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point. All prices are in cents per pound.

Copper is commonly sold on terms "delivered," which means that the seller pays the freight from refinery to buyer's destination. The delivery cost varies, and it would be confusing to figure net prices on individual transactions. Consequently, an average deduction is made from the "delivered" price. At present the average cost of delivery from New York refineries is 0.15c. per lb., and that deduction is made to arrive at the New York price. When copper is sold f.o.b. or f.a.s. New York, of course no deduction is made.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
19	93½	95	111	275¼	282	35½	36	41	42½
20	93½	95¼	111	270	278	35¾	36¼	41⅛	42⅜
21	....	....	...	....	....	...	...	...	...
23	94	95½	111	267½	274	35⅞	36½	40¾	42¼
24	94¼	95½	111	262¾	269½	35⅞	36¼	40¼	41⅜
25	94¼	95¾	111	262½	269¾	35¾	36	40	41½

The above table gives the closing quotations on the London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Aug.	Sterling Exchange	Silver			Aug.	Sterling Exchange	Silver		
		New York, Domestic Origin	New York, Foreign Origin	London			New York, Domestic Origin	New York, Foreign Origin	London
19	360	99½	98½	61	23	358	99½	97¼	60⅞
20	358½	101¾	101¾	63¾	24	354	99½	96	60⅜
21	359	101¾	101¾	63¾	25	354½	99½	97	61

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

On the authority of the Secretary of the Treasury, we quote 100c. per oz. for silver, 1,000 fine, delivered at the option of the Director of the Mint to the New York Assay Office or to the mints in Philadelphia, Denver, or San Francisco, and proved to the satisfaction of the Treasury Department to have been mined, smelted, and refined in the United States. This quotation is retroactive to May 13.

Metal Markets

New York, Aug. 25, 1920

Conditions show little change from last week. In general, buying is on a small scale, and only the immediate requirements of consumers are apparently being provided for. Potential buyers consider that, with the general price decline and tight money conditions, purchases can well be postponed. It is extremely unlikely, however, that the price of any of the major metals will experience any drop of consequence during the next few months. The big depressing influence just now is the London market.

Transportation conditions are generally satisfactory, and movements to and from the Eastern refineries are approaching normal. Transatlantic freight rates are weaker.

Copper

The stagnation has continued during the last week, with selling confined to small lots of spot metal by second-hands who were forced to unload at 18¼c. delivered. Some of the smaller producers were asking 18½@18⅝c. and the larger producers 18¾c. The latter, however, did no business except in special shapes, such as billets, which could not be procured elsewhere. Prices for forward delivery are purely nominal.

Lead

Importations from Europe have gone far to satisfy the demand for prompt lead due to increased consumption and decreased domestic production. About 6,000 to 8,000 tons have been purchased abroad so far this month. Those who have imported direct have been able to secure metal for September delivery at about 8¼c., duty paid, New York, or even less, but when bought through dealers here 8½@8⅝c. has been asked. Surprise has been shown that the price of lead in London has not advanced. Available stocks seem to be larger than supposed and Spanish lead is being received in England which formerly went to France. Very heavy offers, fifteen to eighteen thousand tons, have been made in this market of antimonial lead, as used for shrapnel bullets, at as low as 6¼c. duty paid. This contains 9 to 12 per cent of antimony and is suitable for certain purposes, such as type metal. Forward lead is quoted at 8@8½c. New York and St. Louis, depending upon time of delivery.

Zinc

The large producers got ahead of the market during the last week and quoted 8.20@8.25c. but were unable to make sales, for all of the smaller interests were busy unloading at close to 8c. Yesterday a new factor entered the market in the shape of European offers of American and other zinc at slightly under 8c., duty paid, New York. Two lots of 500 tons each are reported taken. It is difficult to see how importation of this zinc can pay under current conditions, for it is unlikely that it can be proved not to be dutiable. Its effect may be more sentimental than direct, but the fact remains that it has temporarily killed the domestic market, just when producers were beginning to feel more cheerful. The statistical position of domestic zinc continues strong, and slight premiums are being asked for forward delivery.

Tin

The dearth of interest in tin continues. The London price governs the New York market and the price there has dropped continuously during the last week. Former large consumers are buying only from hand to mouth.

Straits tin for future delivery: Aug. 19th, 47.50@48.00c.; 20th, 47.00@47.50c.; 21st, 47.00@47.25c.; 23d, 46.50@47.00c.; 24th, 45.50@46.00; 25th, 45.75@46.00c.

Arrivals of tin in long tons: Aug. 17th, London, 20; 19th, Straits, 40; 20th, Liverpool, 95; Singapore, 100; 21st,

China, 400; Liverpool, 35; Straits, 975; 24th, London, 25.

Silver

The silver market last week continued strong, with advancing tendency on buying for China account, with China banks paying prices in New York which were higher than the equivalent of the London quotation. On Aug. 20 and 21, however, the London market jumped to 63⅜d., which made the London bid price about 2c. higher than the U. S. Treasury price for silver under the Pittman Act. This sharp advance brought out large offerings of silver, both "Domestic" and "Foreign," which were thrown on the London market, with the result that buyers were satisfied and a sharp reaction occurred on Aug. 23 to 60⅝d. Since the culmination of this advance the market has been quiet, with small business, but the closing tendency appears to be firmer on improvement of both London and Far Eastern exchanges.

Mexican Dollars—Aug. 19th, 75; 20th, 76½; 21st, 76½; 23d, 74¼; 24th, 73⅝; 25th, 74¼.

Gold

Gold in London on Aug 19th, 114s. 7d.; 20th, 115s.; 23d, 115s. 3d.; 24th, 115s. 6d.; 25th, 116s.

Foreign Exchange

Weakness, due to conditions mentioned before, continues. Yesterday francs were 6.84c.; lire, 4.55c.; and marks, 1.94c. New York funds in Montreal, 13⅛ per cent premium.

Other Metals

Aluminum — Ingot, 99 per cent and purer, 35.1c.; 98@99 per cent, 34.9c. Virgin metal still obtainable in open market at about 32.5c. for 98@99 grade.

Antimony—Market continues weak. Spot, 7c. per lb.; Cookson's "C" grade, 14@15c. Chinese and Japanese brands, 7c. W. C. C. brand, 9@9½c. [1]Chinese needle antimony, lump, firm at 8@9c. per lb. Standard powdered needle antimony (200 mesh), 10@12c. per lb.

Bismuth—$2.70 per lb., 500-lb. lots, and $2.72 per lb., 100-lb. lots. Market quiet.

Cadmium—Nominal, $1.40@$1.50 per lb. Market steady.

Cobalt—Metal, $3 per lb.; black oxide, $2 per lb.

Iridium—Nominal, $350 per oz. Heavy demand, but small supplies.

Magnesium—Crude, 99 per cent or over pure, $1.75 per lb., for the metal in 100 lb. lots and over, f.o.b. Niagara Falls.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Ingot, 43c.; shot, 43c.; electrolytic, 45c., f.o.b. Bayonne, N. J.; Monel metal, shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—Open market, $50@$75 per troy oz.

Palladium—$100@$110 per oz.

Platinum — Firm at $115@$120 per oz. $105 per oz. in 100 oz. lots.

Quicksilver — Market quiet; $83 per 75-lb. flask. San Francisco wires $81. Dull.

Ruthenium—$200@$220 per troy oz.

[1]**Selenium**, black, powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb. Demand strong.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

Metallic Ores

Bauxite—About 52 per cent alumina content, less than 2 per cent iron oxide, up to 20 per cent silica and artificially dried to contain not more than 4 per cent free moisture, $10 per gross ton at mine; 54 per cent alumina and about 15 per cent silica, $11; averaging 57 per cent alumina, 8 to 12 per cent silica, less than 3 per cent iron oxide, $13 on basis of 8 per cent free moisture. Ores of very low silica content suitable for the manufacture of aluminum oxide and hydrate of alumina command a fancy price.

Chrome Ore—Guaranteed 50 per cent Cr_2O_3 foreign ore with a minimum of 6 per cent silica, 80@85c. per unit, New York. California concentrates, 50 per cent Cr_2O_3 and upward, 60@65c.

Iron Ores—Lake Superior ores, per ton, delivered at Lower Lake ports: Old Range bessemer, $7.45; Old Range non-bessemer, $6.70; Mesabi bessemer, $7.20; Mesabi non-bessemer, $6.55. Congestion at Lake Erie ports due to car shortage has resulted in decreased tonnage. The movement of ore to inland furnaces is not satisfactory.

Manganese Ore — 70@80c. per unit, 50 per cent Mn content, c.i.f. Atlantic seaport; chemical ore (MnO_2) $75@$85 per gross ton.

Molybdenum ore—85 per cent MoS_2, 75@85c. per lb. of contained sulphide, New York.

[1]**Tantalum Ore**, guaranteed minimum 60 per cent tantalic acid, 55@65c. per lb. in ton lots, against recent price of 65@70c.

Titanium Ores—Ilmenite[1], 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 15c. per lb. for ore, with concessions on large lots or running contracts.

Tungsten Ore—Scheelite, 60 per cent WO_3 and over, per unit of WO_3, $7 f.o.b. mines; wolframite, 60 per cent WO_3 and over, per unit of WO_3, $6@$7, in New York.

Uranium Ore (Carnotite)—$2.75@$3 per lb. for 96 per cent of the contained oxide (U_3O_8). Ores must contain a minimum of 2 per cent U_3O_8.

Vanadium Ore—$1.25 per lb. of V_2O_5 (guaranteed minimum of 11 per cent V_2O_5), New York.

[1]**Zircon**—Washed, iron free, 5c. per lb.

[1]**Zirkite**—$90@$100 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., Aug. 21.—Zinc blende, per ton, high, $51.40; basis 60 per cent zinc, premium, $48.50; Prime Western, $47.50; fines and slimes, $45@$42.50. calamine, basis 40 per cent zinc, $36. Average settling prices: Blende, $46.25; calamine, $38.20; all zinc ores, $46.

Lead, high, $107.50; basis 80 per cent lead, $100@$110; average settling price, all grades of lead, $102.40 per ton.

Shipments for the week: Blende, 10,543; calamine, 195; lead, 1,355 tons. Value, all ores the week, $633,710.

The receipt of a larger number of cars this week afforded slight relief to the transportation shortage.

Platteville, Wis., Aug. 21.—Blende, basis 60 per cent zinc, $51@$53 per ton for high-grade. Lead ore, basis 80 per cent lead, $105 per ton. Shipments for the week: Blende, 1,146; lead, 33 tons. Shipments for the year: Blende, 45,770; calamine, 2,330; lead, 3,840; sulphur ore, 1,209 tons. Shipped during the week to separating plants, 1,685 tons blende.

Non-Metallic Minerals

Asbestos — Crude, No. 1, $2,400@$3,000; No. 2, $1,400@$1,700; spinning fibres, $400@$800; magnesia and compressed sheet fibres, $325@$400; shingle stock, $110@$150; paper stock, $60@$75; cement stock, $17.50@$30; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as Canadian royalty export sales tax. Freight rate from mines to Sherbrooke, Quebec, over Quebec Central R.R., 20c. per cwt.; from Sherbrooke to New York, 27½c., carload lots; freight to New York for crude No. 1, f.o.b. Thetford mines, $8.45 per ton, carload lots. Market very strong, owing to heavy demand and a production that is 25 per cent below normal. Higher prices for all grades of material are expected soon.

Barytes — Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $22@$25 in bags, carload lots; (off-color) $18@$20 in bags, carload lots; all f.o.b. Kings Creek, S. C. Crude, 88 to 94 per cent, $12 per gross ton; ground (white) $23@$25; ground (off color) $16@$19 per net ton, f.o.b. Cartersville, Ga. Crude, 88 to 94 per cent, $23; ground (white) $40.50; ground (off color) $27 per net ton, less than carload lots, f.o.b. New York. Crude, not less than 98 per cent, $11@$11.25 per ton, f.o.b. cars, Missouri; floated, $28 per ton in bbls.; $26.50 per ton in 100-lb. bags; extra charge for bags, f.o.b. St. Louis.

Chalk—Domestic, extra light, 5@6c. per lb.; light, 4½@5½c.; heavy, 4@5c; English, extra light, 5@7c.; light, 5@6c.; dense, 4½@5c. per lb., all f.o.b. New York.

China Clay (Kaolin) — Crude, $9@$12; washed, $12@$15; powdered, $18@$22; bags extra, per net ton, f.o.b. mines, Georgia; crude, $8@$12; ground.

$15@$40, f.o.b. Virginia points. Domestic lump, $10@$20; powdered, $25@$30; imported lump, $25@$35; powdered, $30@$60, f.o.b. New York.

Feldspar—Crude, $8@$18 per gross ton, f.o.b. Maryland and North Carolina points; $7.50@$10, f.o.b. Maine; ground, $25@$30 car lots, f.o.b. Baltimore; ground, $17@$20, f.o.b. North Carolina points; $17@$20 per ton, No. 1 ground, f.o.b. New York State; $21@$23 per ton, ground, f.o.b. Maine.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $25 per ton, f.o.b. Illinois mines, and $27.50, f.o.b. Kentucky; ground, suitable for acid, chemical or enameling purposes, $60; lump, $17.50, f.o.b. Tonuco, N. M.

Graphite—Crucible flake, 85 per cent carbon content, 8c. per lb.; 88 per cent, 9½c.; 90 per cent, 10½c., all f.o.b. New York. Crucible grades of Alabama graphite sell as follows, f.o.b. Ashland, Ala.: 80 per cent, 5c.; 90 per cent, 10c. Lubricating grades in increasing demand, with price ranging from 11c. for the 85 per cent guaranteed grade in car lots to 30 and 40c. for higher grades. Mexican, amorphous, $45@$55 per short ton; Korean, 3½c. per lb.; Madagascar, 8c.; Ceylon, 4½@15½c.

Gypsum—Raw crushed rock, $3.50@$4 per ton; raw ground fine, $4@$4.50; calcined stucco, $9, all f.o.b. works. Containers extra. The last price quoted for plaster of paris in carload lots was $4.25 per 250-lb. bbl., alongside dock, New York; but a new price, not yet made public, went into effect on Aug. 26.

Kaolin—See China Clay.

Limestone—Dolomite, 1@2 man size, $1.60@$1.65; 2@8 in., $1.55@$1.65 per net ton, f.o.b. Plymouth Meeting, Pa.; fluxing, $1.65@$1.75 per net ton, f.o.b. Howellville, Pa.

Magnesite, Calcined — High-grade caustic calcined, lump form, $35@$40 per ton, carload lots, f.o.b. California points. Freshly ground calcined, suitable for flooring trade, $65@$75 per ton, f.o.b. Eastern points.

Dead-Burned — $32.50 per net ton, Chewelah, Wash.; $52@$58, Chester, Pa. Austrian grade, $52@$55 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

Mica—Imported block mica slightly stained, per lb.: No. 6, 50c.; No. 5, $1.20@$1.40; No. 4, $2@$3; No. 3, $4.25@$5; No. 2, $5.50@$7; No. 1, $8. Clear block: No. 6, 55c.; No. 5, $2; No. 4, $4; No. 3, $5.75; No. 2, $7; No. 1, $9; A1, $14; extra large, $25, all f.o.b. New York; ground, $85@$100 per ton, Philadelphia.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, $35 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $13; 75 per cent, $11.50; 75@74 per cent, $11; 70 per cent, $8.35; 68 per cent, $7.85; 68@66 per cent, $7.60. There is no price schedule for spot for domestic uses.

Pumice Stone—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish, fines, per unit 12c., c.i.f. Atlantic seaport; furnace size, 17½c.; run of mine, 12@14c.; domestic, fines, f.o.b. mines, 12@14c.

Quartz—(Acid tower) fist to head, $10; 1¼ to 2 in., $14; rice, $17, all net ton, f.o.b. Baltimore; lump, carload lots, $5@$7.50 net ton, f.o.b. North Carolina mines. F.o.b. Wausau, Wis., the price is $16 per ton in car lots, and $22 less quantities, including bags.

Sulphur—$18 per ton for domestic; $20 for export, f.o.b. Texas and Louisiana mines.

Talc — Paper making, $10@$20 per ton; roofing grades, $9@$15; rubber grades, $10@$15, all f.o.b. Vermont. California talc, $20@$45, talcum powder grade. Southern talc, powdered, carload lots, $15@$20 per ton; less than carload, $25, f.o.b. cars; freight to New York $5.25 per ton, carload lots; less than carload lots, $9.25. Imported, $60@$70; Canadian, $20@$40 per ton.

Mineral Products

Arsenic—White arsenic, 15½c. per lb.; sulphide, powdered, 20@21c. per lb., f.o.b. works, carload lots.

Nitrate—Soda, $3.85 per cwt., ex vessel, Atlantic ports. Market quiet.

Potassium Sulphate—Domestic, $2.25@$2.50 per net ton, basis 90 per cent, f.o.b. New York.

Ferro Alloys

Ferrocarbontitanium—For 15-18 per cent material, $200@$250 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15. Foreign conditions as affecting the price of American goods remain unchanged.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 17@18c. per lb. of chromium contained; 4 to 6 per cent carbon, 19@20c. f.o.b. works.

Ferromanganese—For 76@80 per cent, prompt delivery, $200@$210, freight allowed; last half, $200@$220; English, $190@$200, c.i.f. Atlantic seaports. Spiegeleisen, 18@22 per cent, $75@$80, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50@$3 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $60@$65; 50 per cent, $80@$85; 75 per cent, $150@$160.

Ferrotungsten—70 to 80 per cent W, $1.10@$1.15 per lb. of contained tungsten, f.o.b. works.

Ferro-uranium—35-50 per cent U, $7 per lb. of U contained, f.o.b. works.

Ferrovanadium—Basis 30-40 per cent, $6.50@$9.50 per lb. of V contained, f.o.b. works.

Metal Products

Copper Sheets — Current New York price, 29½c. per lb.; wire quoted, 22½@23c.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Lead Sheets—Full lead sheets, 11c.; cut lead sheets, 12½c. in quantity, mill lots.

Nickel Silver—Unchanged at 39½c. per lb. for 18 per cent nickel.

Yellow Metal — Dimension sheets, 26¾c.; sheathing, 25¾c.; rods, ¾ to 3 in., 23¾c.

Zinc Sheets—$12.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 12c. per lb.

Refractories

Bauxite Brick—56 per cent alumina, $145 per 1,000, f.o.b. Pittsburgh.

Chrome Brick—$90@$100 per net ton, carload lots, eastern shipping points.

Chrome Cement—45 to 50 per cent Cr_2O_3, $50 per net ton, and $55 in sacks, carload lots, eastern shipping points.

Clay Brick — First-quality fire clay, 9-in. shapes, $50@$55 per thousand, Pennsylvania, Ohio, and Kentucky works; second quality, $45@$50. First quality, St. Louis, $45; New Jersey, $75.

Magnesite Brick—$100@$110 per ton, eastern shipping points; 9-in. straights, $90@$100; 9-in. arches, wedges and keys, $95@$105; soaps and splits, $110@$120.

Silica Brick—9-in. per 1,000, $51@$55, Birmingham, Ala.; $55@$60, Mount Union, Pa.; $55, Chicago district.

Iron Trade Review

Pittsburgh, Aug. 24, 1920

With a dull market in the iron and steel trade generally, an advance of $4 a ton in the quotation price of foundry pig iron at Valley furnaces, to a $50 level, stands out as spectacular, and the advance is none the less interesting through its being based upon relatively light transactions.

Pig Iron.—Sales of foundry iron totaling probably between 5,000 and 10,000 tons have been made at $50, Valley, chiefly for early deliveries, but in a few instances for shipment during the remainder of the year, and the market is thus established at a $4 advance. Bessemer and basic are reported to have sold at $50 or thereabouts, but transactions have been too light to establish a new basis definitely, and the market is quotable as follows: Bessemer, nominal, $47; basic, nominal, $46.50; foundry, $50, f.o.b. Valley furnaces, existing freight to Pittsburgh being $1.40, to advance this week by 40 per cent. Most pig-iron buyers are disposed to avoid the market, doubting whether present prices are justified.

Steel.—Several sales of sheet bars have been made at $67.50, Pittsburgh, and some buyers now in the market express confidence that they will be able to do $65. The market is quotable at $67.50@$70 for sheet bars, with billets at $60@$65, and quite inactive.

Charcoal and Coke

Charcoal—Willow, 7c. per lb. in bbls.; hardwood, 6c. per lb., in 250-lb. bbls.

Connellsville — Furnace, $17@$18: foundry, $18@$20.

The Importance of European Copper Purchases

Copper Industry Would Be Relieved of Its Difficulties If Export Trade Increased — Other Nations Must Replace Germany's Important Position Before Pre-War Scale of Buying Is Assured—Electrical Developments Portend Important Copper Purchases

THE copper industry is waiting for the important export trade which it possessed in the years before the war, to assist it out of its present difficulties. Some measure of relief from the unfortunate condition of the copper industry was afforded through export business during the last half year, and domestic business also helped magnificently. The great obstacle to dependence upon foreign copper orders is not only the important financial disabilities that must be overcome, but the uncertainty attached to European and Asiatic requirements and to the ability of foreign countries to use more copper than that required for their own needs. The assumption that Europe is generally bare of copper stocks, or nearly so, may be true, but there are undoubtedly large stocks of scrap metal and second-hand material left over from the war which are ready to be consumed in peace-time use.

Aside from the question of scrap copper, the record of the various European nations as importers of American copper is highly significant. Roughly, over half of all the refined copper produced in the United States was shipped abroad in the five years before the war. At the same time the annual domestic consumption of copper was a little under 50 per cent of production. Practically all of the copper exported was shipped to Europe, Canada being the only other consumer of note, but only to a relatively small extent, taking about 3,000,000 lb. of refined copper monthly. England, France, Germany, The Netherlands, and Italy were the important destinations for exported copper, and all combined to sustain a brisk and exceedingly important export trade. The accompanying table gives a record of the quantities of copper consumed by these countries during the last ten years.

The most important customers from 1910 to 1914 were Germany and The Netherlands, both together accounting for over half the exports of copper from the United States. However, it is now generally understood that the heavy purchases of The Netherlands and also some other European countries were principally for the German market. Thus, to obtain the true significance of German copper importations, the copper imports of The Netherlands, Belgium, and Denmark should be added to those of Germany. Proceeding a logical step farther, and including the buying of Austria-Hungary (35,000,000 lb. annually), the foreign copper consumption by the Central Powers is much more than that of all other countries combined. Enormous quantities of copper were required by these countries. A warrantable estimate would be 500,000,000 to 550,000,000 lb. annually. This great buying power is now withdrawn from the market, except for driblets of copper that occasionally find their way to the former enemy countries. Nor is there immediate prospect of a resumption of this trade. The German price of United States copper at 9 to 10 marks per pound is prohibitive. Furthermore, financial and industrial conditions in Germany are in no condition to warrant hope that the nation will soon resume the development and expansion of her electrical industries on a scale approaching that prevailing before the war.

If Germany is unable to occupy her former important position in the copper market, are any other countries likely to supplant her? The indications point to just such a state of affairs at this time. The United States is consuming copper at an unprecedented peace-time scale, and although a good portion of this consumption is answering the call of construction curtailed during the war, much of it is being used in the electrical and other manufacturing trades for export purposes. The United States undoubtedly has a splendid opportunity to capture export fields formerly monopolized by other powers, and the copper industry will readily reflect the measure of success coming from such an attempt.

The demand for copper by the European nations was originally predicated upon their being compelled to replace the copper lost through the devastation of the war—not upon the ability of these nations to export copper manufactures, which is a subordinate consideration and an opportunity thrust upon them by the results of the war. The financial difficulties which must be overcome, and which were thought to have been surmounted by the plans of the Copper Export Association, are evidently still of serious moment, for consistent buying from France and Europe in general has not been manifested. Foreign support from unusual quarters—from Japan and Scandinavia—was a feature of the market in the last eighteen months. Japan had never figured prominently in export trade, but consumed large quantities of copper in 1919 and 1920 in anticipation of satisfying Asiatic requirements for copper and copper manufactures, thereby replacing Germany in a field which that country formerly tried to monopolize. The financial crash in Japan, and its attendant results, have put a temporary brake on such Japanese plans for expansion. Incidentally, there is little reason why American manufacturers cannot become strong contenders for Asiatic markets for copper and copper goods.

Another element in foreign copper purchases is the fact that industry and commerce are adopting electricity in an effort to conserve fuel. The acute coal shortage in Europe —and in the United States—is forcing nations to resort to "white coal," the fuel of the future. France, Italy and Switzerland have outlined extensive programs for hydro-electric development which if consummated should use large quantities of copper.

The world is turning more and more to oil and electricity for a solution of its fuel problems, and of these two, electricity will become of continually greater importance. Hydro-electric projects all over the world should draw increasing amounts of copper from the United States. But everything depends upon Europe obtaining the financial assistance which it needs before it is in a position to purchase much copper. An official of an important copper-producing company aptly summed up the situation a few days ago to this effect: "Foreign exchange rates are seriously hampering these countries in their efforts at reconstruction, so that their purchases of raw materials, such as copper, of which they are vitally in need, will be delayed until such time as they can more advantageously fill their requirements."

EXPORTS OF METALLIC COPPER FROM THE UNITED STATES IN POUNDS

					(A) Exports in Per Cent of United States Production.							
Year	To England	(A)	To France	(A)	To Germany	(A)	To Netherlands	(A)	To Italy	(A)	Total Exports	(A)
1910	98,000,000	6.8	116,000,000	8.1	176,000,000	12.2	222,000,000	15.5	34,000,000	2.4	708,000,000	49.8
1911	108,000,000	7.5	135,000,000	9.4	190,000,000	13.3	231,000,000	16.0	38,000,000	2.7	787,000,000	55.0
1912	95,000,000	6.1	131,000,000	8.4	252,000,000	16.2	153,000,000	9.7	47,000,000	3.0	775,000,000	49.5
1913	34,000,000	2.1	160,000,000	9.9	307,000,000	19.0	179,000,000	11.1	41,000,000	2.6	926,000,000	52.4
1914	198,000,000	12.9	150,000,000	9.8	177,000,000	11.5	126,000,000	8.2	67,000,000	4.4	840,000,000	54.8
1915	201,000,000	12.3	236,000,000	14.5	.....	....	4,000,000	.2	107,000,000	6.6	682,000,000	41.8
1916	173,000,000	7.7	318,000,000	14.1	.....	....	.....	....	98,000,000	4.3	784,000,000	34.8
1917	373,000,000	15.3	366,000,000	15.1	.....	....	.....	....	153,000,000	6.3	1,126,000,000	46.5
1918	252,000,000	10.4	265,000,000	10.9	.....	....	.....	....	122,000,000	5.0	744,000,000	30.7
1919	106,000,000	5.9	89,000,000	5.1	.....	.....	.....	....	65,000,000	3.7	516,000,000	29.3

In pre-war years Austria-Hungary imported about 35,000,000 lb. United States copper, and Belgium 7,000,000 lb., annually.

COMPANY REPORTS

Second Quarter of 1920

Utah Copper Co.

Copper; Utah

A comparative production statement of the Utah Copper Co. follows:

Second Quarter 1920	Lb.	First Quarter 1920	Lb.
April	9,313,227	January	9,151,144
May	9,829,781	February	9,211,806
June	9,554,119	March	8,894,596
Totals	28,697,127		27,257,546
Average monthly production	9,565,709		9,085,849

In addition to the above, 307,254 lb. of copper was contained in precipitates from the leaching plant.

The average cost per pound of net copper produced, including plant depreciation and all fixed and general charges, but excluding Federal taxes, and without credit for gold and silver or miscellaneous income, was 13.697c., as compared with 13.202c. for the previous quarter, calculated in the same way. The value of the gold and silver in the concentrates totaled $235,544.54, and the miscellaneous income amounted to $300,767.25. These items combined are equal to 1.929c. per net lb. of copper produced.

Financial results compare as follows:

	Second Quarter 1920	First Quarter 1920
Net profit from copper production only	$1,254,033.15	$2,291,012.91
Miscellaneous income, including payment for precious metals	536,311.79	329,451.95
Income from Nevada Consolidated Copper Co.	250,125.00	250,125.00
Income from Bingham & Garfield Railway Co.	200,000.00	.....
Total net profit	$2,240,469.94	$2,870,589.86
Disbursements to stockholders	2,436,735.00	2,436,735.00
Net surplus for the first quarter		$ 433,854.86
Net deficit for the second quarter	$ 196,265.06	

The earnings for the second quarter are computed on the basis of 18.209c. for copper, as against 21.994c. for the previous quarter. The regular quarterly disbursement of $1.50 per share was paid on June 30.

Nevada Consolidated Copper Co.

Copper; Nevada

Nevada Consolidated Copper Co.'s production compares:

Second Quarter 1920	Lb.	First Quarter 1920	Lb.
April	4,061,237	January	3,687,098
May	4,351,712	February	3,700,106
June	4,650,718	March	3,751,021
Totals	13,063,667		11,138,225
Average monthly production	4,354,556		3,712,742

The cost of production of copper for the quarter, including the fixed charges to cover depreciation of plant and equipment and all administrative and general overhead expenses, and after crediting miscellaneous income, was 15.56c. per lb., as compared with a cost of 20.72c. per lb. for the preceding quarter.

Financial results compare as follows:

	Second Quarter 1920	First Quarter 1920
Operating profit	$47,276.49	$132,529.28
Miscellaneous income, including that from Nevada Northern Railway Co. and payment for precious metals	336,723.69	83,053.86
Net gain	$384,000.18	$215,583.14
Distributions to stockholders	499,864.25	499,864.25
Net deficit	$115,864.07	$284,281.11

The operating earnings for the quarter are based upon an average carrying price of 18.50c. per lb. of copper produced, as compared with an average basing price of 22.66c. per lb. for the quarter ending March 31, 1920. A quarterly distribution of 25c. per share was made on June 30.

Chino Copper Co.

Copper; New Mexico

Chino Copper Co.'s production compares as follows:

Second Quarter 1920	Lb.	First Quarter 1920	Lb.
April	3,750,975	January	3,081,937
May	3,946,684	February	3,129,776
June	4,282,956	March	4,409,563
Totals	11,980,615		10,621,276
Average monthly production	3,993,538		3,540,425

In addition to the copper derived from the concentrating ores, a total of 8,836 lb. of copper was contained in ores sent direct to the smelter.

The cost per pound of net copper produced during the second quarter of 1920, including plant depreciation and all other items except charges for Federal taxes, but without credit for precious metals and miscellaneous income, was 15.90c., compared with 14.62c. for the first quarter of 1920. The value of gold and silver and miscellaneous earnings was $70,120.39, or 0.61c. per lb. of net copper produced.

Financial results compare as follows:

	Second Quarter 1920	First Quarter 1920
Net income from copper production only	$260,031.67	$737,605.40
Miscellaneous income, including payments for precious metals	70,120.39	72,121.75
Totals	$330,152.06	$809,727.15
Distribution to stockholders	326,242.50	326,242.50
Surplus after distribution to stockholders	$ 3,909.56	$483,484.65

The earnings for the second quarter of 1920 are based on a price for copper of 18.175c. per lb., compared with 21.88c. for the first quarter of the year. A quarterly distribution to stockholders amounting to 37½c. per share was paid.

Ray Consolidated Copper Co.

Copper; Arizona

Ray Consolidated Copper Co.'s production compares:

Second Quarter 1920	Lb.	First Quarter 1920	Lb.
April	4,153,305	January	3,891,710
May	4,211,886	February	3,783,044
June	4,515,414	March	3,872,349
Totals	12,880,605		11,547,103
Average monthly production	4,293,535		3,849,034

In addition to the copper derived from concentrating ores, a total of 84,991 lb. of copper was contained in ores sent direct to the smelter. The average cost per pound of all net copper produced for the quarter was 15.688c. This does not take into account any credit for the gold and silver or for miscellaneous income, and compares with a cost of 16.745c. for the previous quarter. These costs include a charge of 15c. per ton of ore treated, for the retirement of mine development expense, but are exclusive of estimate of Federal income and profit taxes. Miscellaneous income for the quarter, including net income from gold and silver produced, amounted to 0.347c. per lb.

Financial results compare as follows:

	Second Quarter 1920	First Quarter 1920
Operating profit	$343,650.73	$587,165.50
Miscellaneous income	43,604.72	50,134.39
Totals	$387,255.45	$637,299.89
Disbursement to stockholders	394,294.75	394,294.75
Net surplus for the quarter	$ 7,039.30*	$243,005.14

*Deficit.

The average carrying price of copper for the quarter was 18.426c., as compared with 21.960c. for the previous quarter. A quarterly distribution to stockholders of 25c. per share was paid June 30, 1920, and amounted to $394,294.75.

MINING STOCKS

Week Ended August 21, 1920

Stock	Exch	High	Low	Last	Last Div.		
COPPER							
Adventure	Boston	*50	*50	*50			
Ahmeek	Boston	...	...	58	June '20, Q	.50	
Alaska-B.C.	N. Y. Curb	1	3/4	1			
Allouez	Boston	21	21	21	Mar. '19,	1.00	
Anaconda	N. Y.	52½	50⅝	52½	Aug. '20, Q	1.00	
Ariz. Com'l	Boston	9¼	9	9	Oct. '18	.50	
Big Ledge	N. Y. Curb	1/8	1/16				
Bingham Mines	Boston	8¼	8⅛	8⅛	Sept. '19, Q	.25	
Calumet & Ariz.	Boston	54¾	54	54¾	June '20, Q	1.00	
Calumet & Hecla	Boston	300	290	300	June '20, Q	5.00	
Canada Copper	N. Y. Curb	1/16	1/8	1/16			
Centennial	Boston	...	...	11	Dec. '18, SA	1.00	
Cerro de Pasco	N. Y.	38	37	38	June '20, Q	1.00	
Chief Consol.	Boston Curb	3	3	3	Feb. '20, Q	.10	
Chile Cop	N. Y.	14	13⅛	14			
Chino	N. Y.	26	25	26	June '20, Q	.37½	
Columbus Rexall	Salt Lake	*40	*38	*38			
Con. Ariz.	N. Y. Curb	1/16	1/8	1/8	Dec. '18, Q	.05	
Con. Copper M.	N. Y. Curb	...	...	2⅞			
Copper Range	Boston	34¼	32⅛	33	June '20, Q	.50	
Crystal Copper	Boston Curb	*38	*26	*37			
Davis-Daly	Boston	7⅜	7¼	7¼	Mar. '20, Q	.25	
East Butte	Boston	10½	9⅛	10	Dec. '19, A	.50	
First Nat'l	Boston Curb	*90	*76	*85	Feb. '19, SA	.15	
Franklin	Boston	...	...	*50			
Gadsden Copper	N. Y. Curb	...	...	*71			
Granby Consol.	N. Y.	36	31⅜	36	May '19, Q	1.25	
Greene-Cananea	N. Y.	24⅜	23⅛	24⅛	Aug. '20, Q	.50	
Hancock	Boston	3½	3	3			
Houghton	Boston Curb	...	...	*40			
Howe Sound	N. Y. Curb	...	...	3½	July '20, Q	.05	
Inspiration Con.	N. Y.	46	44⅜	46	July '20, Q	1.00	
Iron Cap	Boston Curb	8⅛	8⅛	8⅛	Feb. '19, M	.25	
Isle Royale	Boston	27⅛	26⅛	27	Sept. '19, SA	.50	
Kennecott	N. Y.	24	23⅛	23⅜	June '20, Q	.50	
Keweenaw	Boston	1⅛	1⅛	1⅛			
Lake Copper	Boston	3	3	3			
La Salle	Boston	...	...	2½			
Magma Chief	N. Y. Curb	...	...	*21			
Magma Copper	N. Y. Curb	26	25	25⅛	Jan. '19, Q	.50	
Majestic	Boston Curb	...	...	*12			
Mason Valley	N. Y. Curb	...	...	2⅛			
Mass. Con.	Boston	3	3	3	Nov. '17, Q	1.00	
Mayflower-O.C.	Boston	5¼	4⅜	5¼			
Miami	N. Y.	19	18⅛	19	Aug. '20, Q	.50	
Michigan	Boston	4	3½	3½			
Mohawk	Boston	59	57	58½	Aug. '20, Q	1.50	
Mother Lode (new)	N. Y. Curb	5⅛	5⅛	5⅛			
Nevada Con.	N. Y.	11	10⅜	11	June '20, Q	.25	
New Arcadian	Boston	...	...	3			
New Baltic	Boston Curb	...	...	3			
New Cornelia	Boston	17	16½	16½	Aug. '20,	.25	
Nixon Nev.	N. Y. Curb	...	...	*9			
North Butte	Boston	14½	14	14⅜	Oct. '18, Q	.25	
North Lake	Boston	...	...	1/8			
Ohio Copper	N. Y. Curb	...	...	1⅛			
Ojibway	Boston	...	...	1½			
Old Dominion	Boston	22	20	20	Dec. '18, Q	1.00	
Osceola	Boston	37	36	36	June '20, Q	.50	
Phelps Dodge	Open Mar.	†195	†180	...	July '20, Q	2.50	
Quincy	Boston	44	44	44	Mar. '20, Q	1.00	
Ray Con.	N. Y.	14⅜	14⅛	14⅛	June '20, Q	.25	
Ray Hercules	Boston Curb	...	...	*60			
St. Mary's M. L.	Boston	36⅛	35	35⅛	June '20, K	2.00	
Seneca	Boston	15	12⅜	13⅛			
Shannon	Boston	...	...	1⅛	Nov. '17, Q	.25	
Shattuck Ariz.	N. Y.	...	...	8⅛	Jan. '20, I	.25	
South Lake	Boston	...	...	2			
South Utah	Boston	*15	*15	*15			
Superior	Boston	4	4	4	Apr. '17,	1.00	
Superior & Boston	Boston	3	3	3			
Tenn. C. & C.	N. Y.	9⅛	9⅛	9⅛	May '18, I	1.00	
Tuolumne	Boston	*65	*60	*65	May '13,	.10	
United Verde Ex.	Boston Curb	30⅛	29⅛	30	Aug. '20, Q	.50	
Utah Con.	Boston	6⅛	6⅛	6⅛	Sept. '18,	.25	
Utah Copper	N. Y.	61	57⅛	61	June '20, Q	1.50	
Utah M. & T.	Boston	1 1/16	1	1 1/16	Dec. '17,	.30	
Victoria	Boston	2 1/16	2	2			
Winona	Boston	*40	*30	*40			
Wolverine	Boston	...	...	13	Jan. '20, Q	.50	
LEAD							
Hecla	N. Y. Curb	4¼	4	4¼	June '20, QX	.20	
St. Joseph Lead	N. Y.	16¼	15	16¼	June '20, QX	.50	
Stewart	Boston Curb	...	...	*16	Dec. '15,	.05	
Utah Apex	Boston	1⅛	1⅛	1⅛	Nov. '18,	.25	
ZINC							
Am. Z. L. & S.	N. Y.	12¼	11⅛	12¼	May '17,	1.00	
Am. Z. L. & S. pf.	N. Y.	45	45	45	Aug. '20, Q	1.50	
Butte C. & Z.	N. Y.	7⅛	6⅞	6⅞	June 18, I	.50	
Butte & Superior	N. Y.	19⅛	18⅛	19	Sept. '17,	1.25	
Con. Interst. Cal.	N. Y.	11⅛	9⅛	11⅛	June '20, Q	.50	
New Jersey Z.	N. Y. Curb	185	183	184	Aug. '20, Q	4.00	
Success	N. Y. Curb	*4½	*4	*4½	July '16,	.03	
Yellow Pine	Los Angeles	‡...	...	1.01	June '20, Q	.03	

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	N. Y.	1⅛	1⅛	1⅛		
Alaska Juneau	N. Y.	1¼	1⅛	1⅛		
Carson Hill	N. Y. Curb	...	...	24⅜		
Cresson Consol. G.	N. Y. Curb	1¼	1/8	1¼	June '20, Q	.10
Dome Ex.	Toronto	*38	*31	*36		
Dome Mines	N. Y.	12	11¼	11⅜	July '20, Q	.25
Golden Cycle	Colo. Sprgs.	‡...	...	*73	May '20, Q	.02
Goldfield Con.	N. Y. Curb	*10	*8	*10	Dec. '19,	.05
Hedley	Boston	...	...	4½	June '19,	.10
Hollinger Con.	Toronto	5.75	5.50	5.50	Aug. '20, BM	.05
Homestake	N. Y.	50	50	50	Sept. '19,	.50
Kirkland Lake	Toronto	*59	*54	*54		
Lake Shore	Toronto	1.20	1.10	1.14	Oct. '19,	.02½
McIntyre-Porcupine	Toronto	2.06	2.00	2.00	May '20, K	.05
Porcupine Crown	Toronto	*30	*25	*25	July '17,	.03
Portland	Colo. Sprgs.	‡...	...	*60	July '20, Q	.01½
Reorgan. Booth	N. Y. Curb	5	3½	5	May '19,	.05
Silver Pick	N. Y. Curb	*6	*5	*5½		
Teck Hughes	Toronto	*10½	*7	*8		
Tom Reed	Los Angeles	‡...	...	1.08	Dec. '19,	.02
United Eastern	N. Y. Curb	2⅛	2	2⅛	Apr. '20, Q	.21
Vindicator Consol.	Colo. Sprgs.	‡...	...	*18	Jan. '20, Q	.01
West Dome Consol.	Toronto	*7⅜	*5⅜	*6⅛		
White Caps Min.	N. Y. Curb	*8	*6	*8		
Yukon Gold	Boston Curb	...	...	1⅛	June '18,	.02½
SILVER						
Arizona Silver	Boston Curb	*15	*10	*14	Apr. '20, M	.03
Beaver Con.	Toronto	*47	*43	*43¾	May '20, K	.03
Coniagas	Toronto	3.00	2.25	2.65	Aug. '20, Q	.12½
Crown Reserve	Toronto	25	20	*21½	Jan. '17,	.05
Kerr Lake	Boston	3⅛	3⅛	3⅛	Sept. '19,	1.00
La Rose	Toronto	*34	*32	*32	Apr. '18,	.02
McKinley-Dar.	N. Y. Curb	...	...	*51	July '20, Q	.03
Mining Corp.	Toronto	1.85	1.70	1.75	June '20, Q	.12½
Nipissing	N. Y. Curb	8⅛	8⅛	8⅛	July '20, Q	.25
Ontario Silver	N. Y.	5⅛	5⅛	5⅛	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	1/16	1/8	1/16	Jan. '12,	.10
Peterson Lake	Toronto	*13⅛	*12⅛	*12⅛	Jan. '17,	.01⅛
Temiskaming	Toronto	*37	*34	*36	Jan. '20, K	.04
Trethewey	Toronto	*30	*26	*25	Jan. '19,	.05
GOLD AND SILVER						
Atlanta	N. Y. Curb	*2⅛	*1⅛	*2		
Barnes-King	Butte	‡...	....	1.11	Aug. '20, Q	.05
Bost. & Mont.	Boston	...	...	*63		
Cashboy	N. Y. Curb	*7	*6⅛	*7		
El Salvador	N. Y. Curb	1⅛	1⅛	1⅛		
Jim Butler	N. Y. Curb	*13	*10	*12⅛	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*5	*4⅛	*5	June '16,	.05
Louisiana Con.	N. Y. Curb	1/8	1/8	1/8		
MacNamara M.	N. Y. Curb	1/16	1/8	1/16	May '10,	.02½
N.Y. Hond. Rosar	Open Mar.	†13	†11	...	July '20, QX	.50
Tonopah-Belmont	N. Y. Curb	1⅛	1 1/16	1⅛	Jan. '20, Q	.05
Tonopah-Divide	N. Y. Curb	2	1⅞	1 1/16		
Tonopah Ex.	N. Y. Curb	2	1 1/16	1⅛	July '20, Q	.05
Tonopah Mining	N. Y. Curb	1 1/16	1	1⅛	Oct. '19, SA	.15
West End Con.	N. Y. Curb	1¼	1 1/16	1¼	Dec. '19 SA	.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*21	*18	*20	July, '20, M	.01
Consol. M. & S.	Montreal	25⅜	24½	25⅛	July '20, Q	.62½
Daly Mining	Salt Lake	2.65	2.65	2.65	July '20, Q	.10
Daly-West	Boston	4¼	4¼	4¼	July '20, Q	.25
Eagle & Blue Bell	Boston Curb	...	...	2⅛	Apr. '20, Q	.10
Electric Point	Spokane	*34	*29	*29	May '20, SA	.03
Fed. M. & S.	N. Y.	...	...	10	Jan. '09,	1.50
Fed. M. & S. pf.	N. Y.	35	35	35	June, '20, Q	1.75
Florence Silver	Spokane	*34	*34	*34	Apr. '19,	.01½
Grand Central	Salt Lake	...	...	*37½	June '20, K	.03
Iron Blossom	N. Y. Curb	*33⅜	*22	*22	Apr. '20, Q	.02½
Judge M. & S.	Salt Lake	...	...	4.00	July '20, Q	.12½
Marsh Mines	N. Y. Curb	*13⅛	*12	*13		
Prince Consol.	N. Y. Curb	1/16	1/8	1/16	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*14	*13	*13	Feb. '19,	.01
Rex Con.	N. Y. Curb	...	...	*6		
South Hecla	Salt Lake	*95	*94	*94	Sept. '19, K	0.15
Stand. S. L.	N. Y. Curb	1/16	1/16	1/16	Oct. '17,	.05
Tamarack-Custer	Spokane	2.40	2.25	2.25	Dec. '19, K	.03
Tintic Standard	Salt Lake	3.45	3.32½	3.35	June '20, Q	0.10
Wilbert	N. Y Curb	*4	*3	*4	Nov. '17,	.01
NICKEL-COPPER						
Internat'l Nickel	N. Y.	20½	18⅛	20	Mar. '19,	.50
Internat'l Nick.pf.	N. Y.	...	...	80¾	Aug. '20, Q	1.50
QUICKSILVER						
New Idria	Boston	....	....	5	Jan. '19,	.25
TUNGSTEN						
Mojave Tungsten	Boston Curb	*14	*10	*13		
VANADIUM						
Vanadium Corp.	N. Y.	72⅛	64	72⅛	July '20, Q	1.50
ASBESTOS						
Asbestos Corp.	Montreal	88	82	82	July '20, Q	1.50
Asbestos Corp. pf.	Montreal	94	92	93	July '20, Q	1.75
MINING, SMELTING AND REFINING						
Am. S. & R.	N. Y.	55⅛	53⅜	55⅜	June '20, Q	1.00
Am. S. & R.pf.	N. Y.	88½	88	88½	June '20, Q	1.75
Am. Sm. pf.A	N. Y.	71	71	71	July '20, Q	1.50
U. S. Sm. R. & M.	N. Y.	51⅛	50⅜	51	July '20, Q	1.50
U.S.S.R.& M. pf.	Boston	43⅛	42⅛	43	July '20, Q	.87½

*Cents per share. †Bid or asked. ‡Quotations missing. Q, Quarterly. SA, Semi-annually. BM, bimonthly. K, Irregular. I, Initial. X, includes extra

INDUSTRIAL NEWS

The Easton Car & Construction Co. announces the opening of a new office in the Peoples Gas Building, Chicago, to take care of the increasing business in the West and Middle West districts.

Denver Rock Drill Manufacturing Co., of Colorado, announces the opening, on Aug. 1, of a branch office at 421 Manhattan Building, Duluth, Minn.

Olin H. Landreth, consulting engineer, 156 Fifth Ave., New York City, announces that he is now consulting engineer to the Eastern Potash Corporation, New Brunswick, N. J., and therefore has time available for other engagements in like capacity. ('phone Chelsea 9992).

T. Nelson Dale, geologist, recently with the U. S. Geological Survey, announces that on Aug. 21 last he took up the work of a consulting geologist in problems pertaining to slate, granite, marble, lime-rocks, and drilling for water. Mr. Dale is the author of many authoritative papers on ornamental and building stones of the eastern United States. His address is "The Oaks," Springfield, Mass.

Yale & Towne Manufacturing Co., Stamford, Conn., has moved its general offices to Stamford, Conn., to which all mail should be addressed.

New Convertible Shovel Has Six Changes Simply Made

The Bucyrus Co., South Milwaukee, Wis., has recently described in its bulletin C-301 a new revolving shovel, known as the 30-B, which supersedes the company's 18-B ⅝-yard revolving shovel. The 30-B is in fact a universal machine. It may be used as a revolving shovel, or, with the addition of a few extra parts, as a dragline excavator, a clamshell excavator, a locomotive crane, a sewer shovel, or with a long boom and dipper sticks for work requiring unusually high lifts. It is so designed that these changes may be made with the minimum of labor, delay, and expense by those who have provided the necessary parts in advance.

As a Revolving Shovel

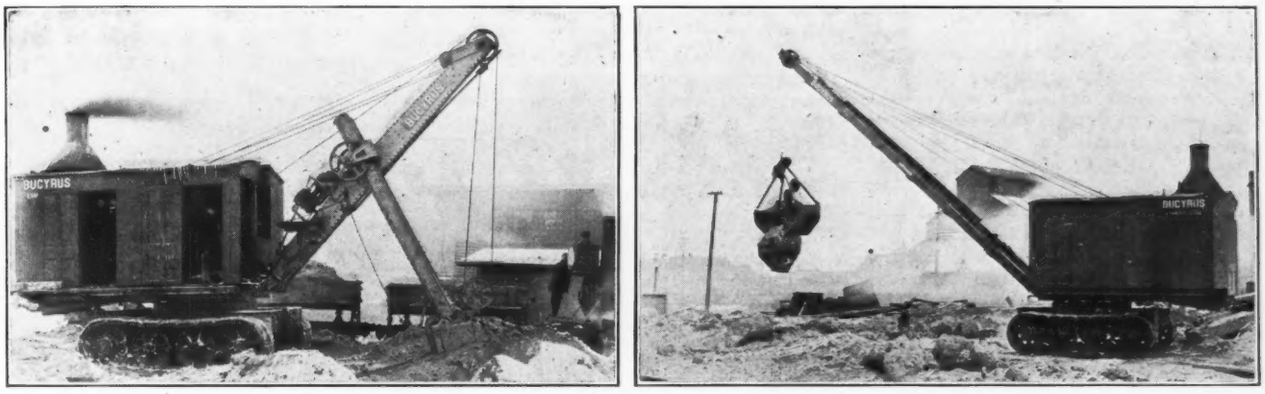
As a revolving shovel it carries a 1-yard dipper truck measure. When heaped up, this capacity is about 1¼ cu.yd. Its truck frame is so designed that it will accommodate caterpillar traction, traction wheels or railroad trucks of any gage from 3 ft. 3 in. to 5 ft. These three mountings are absolutely interchangeable. Such a change can be made in the field at a small expense. The working weight of the 30-B shovel on caterpillars is about thirty-four tons, on traction wheels thirty-one tons, and on railroad trucks 29½ tons. It has sufficient ruggedness and possesses ample power for work in clay pits, rock quarries, and for mining and stripping operations.

As Clamshell Excavator

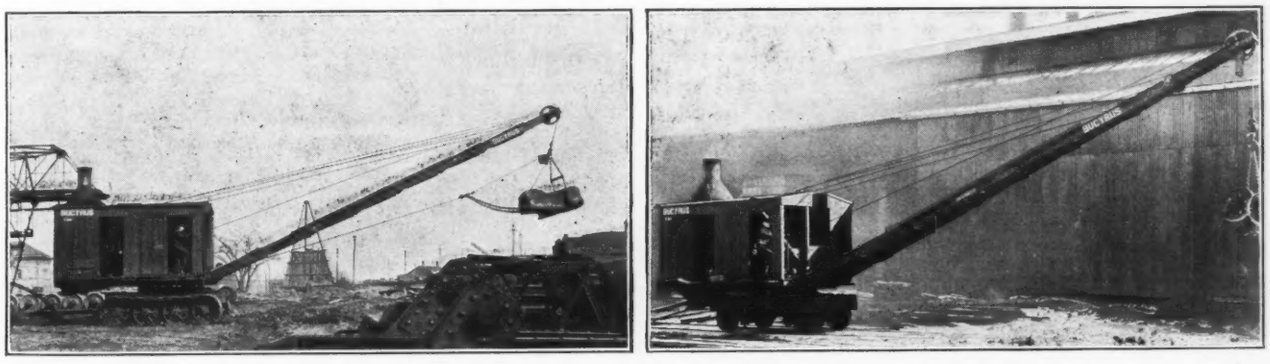
The hand machine will carry a 1-yard clamshell bucket with a 35-ft. boom or a ¾-yd. clamshell bucket with a 40-ft. boom. All the change required in this installation is an additional drum on the main hoist shaft, with the necessary brake, clutch, thrust cylinder, and operating levers, additional ropes, boom, bucket, tag line, and trolley. The changes are simply and readily made.

As Crane

As a crane this shovel has a capacity of 9¾ tons at 20 ft. when mounted on caterpillars, and 9 tons at the same radius when mounted on trucks or traction wheels. To make this change, the same parts are required as for the clamshell machine, with the addition of the hook.



BUCYRUS 30-B AS A REVOLVING SHOVEL AND AS A CLAMSHELL EXCAVATOR



BUCYRUS 30-B AS A DRAGLINE EXCAVATOR AND AS A CRANE

As Dragline Excavator

To convert to a dragline excavator requires the changes named for the clamshell except that the tag line and trolley are not necessary and a fair-lead, drag-bucket and rope must be ordered. It carries a 1-yd. bucket on a 35-ft. boom, or ¾-yd. bucket on a 40-ft. boom.

As Sewer Excavator

The conversion to a sewer shovel is simple. Two combinations of dipper handles are offered. With a 30-ft. handle it will dig a trench 20 ft. deep, and with a 24-ft. handle a trench 14 ft. in depth. It carries a special ¾-yd. sewer dipper, although it may be noted that the standard steam-shovel dipper

may be used for this purpose when the sewer work is not extensive. It may be seen in the illustration that this dipper has no bail, the padlock being pin-connected directly to the dipper-back and the side frames being eliminated. This gives an unobstructed cutting edge with the corners, as well as with the front of the dipper.

FOR HIGH LIFTS

It often happens that a contractor desires an exceptionally high lift and reach, as his work may require loading wagons from deep excavation or for special work of some character. To fulfill this demand, a 26-ft. boom and 17-ft. handle may be purchased.

Special Post-Graduate Training for Technical Men

Arrangements have been completed by the educational authorities of the Western Electric Co. and the faculty of Columbia University, to enable employees of the former to carry on post-graduate courses coincident with their regular duties. This system has been limited to the members of the engineering department, where more than three thousand technical students are eligible to take advantage of the offer. Approved graduates of colleges and scientific schools may pursue graduate work for masters' degrees and fulfill the requirements in two calendar years under certain conditions.

Admission is dependent on an adequate grounding in mathematics and physics. After the candidates are nominated by the officials of their departments, they must meet the academic qualifications of the university. A special course of training in technical work has also been started by the company itself to instruct graduates of arts colleges in its engineering methods. A month is set aside by the educational authorities for groundwork, which is followed by work in the laboratories. The entire course takes nine months. Outside reading and lectures are required during that period.

International Refrigeration Institute

An International Conference of Refrigeration, at which 42 governments, states, dominions and colonies were represented, was held in Paris, on June 21, the French Minister of Agriculture, M. Picard, presiding. The object of the conference was the signing of a convention which creates an International Institute of Refrigeration in Paris, supported by annual subsidies from all the participant states. The aim of this Institute is to stimulate the progress of the science and technics of refrigeration.

The director of the Institute is Emile Gouault and the chairman of the executive committee is André Lebon. They may be addressed care of Institute International du Froid, 9, avenue Carnot, Paris, France.

Some Refillable Fuses Are Reliable

A circular letter recently sent out by the Associated Factory Mutual Laboratories to its associated companies makes the following very important statement affecting every manufacturer in the United States:

"We believe that this test of Underwriters Laboratories on refillable (insertion of new links by consumer) fuses does not bring out the real hazard in the field connected with the type of fuse in question. The Underwriters Laboratories assume no responsibility for the action of the fuses after they have been refilled by the users. Improper refilling can easily occur.

"The Factory Mutual Laboratories are not planning to follow the course of the Underwriters Laboratories. We do not believe that our laboratory should approve a type of fuse whose satisfactory operation depends so greatly upon the treatment it receives by the users."

There is much food for thought in this statement and no manufacturer can ignore its far reaching possibilities and the question each manufacturer should ask himself is, What can I gain by continuing the use of a fuse which *may* cause trouble? Better avoid this possibility by using a fuse which the Factory Mutual Laboratories *approve*, particularly when you can save money by so doing. Factory Mutual Laboratories approve "Atlas" fuses in both 250 and 600 v. up to 100 amp.

Improved Water-Softener Eliminates Scale and Sludge

The hot-process water softener is described in a book recently issued by the **H. S. B. W.-Cochrane Corporation.** formerly the Harrison Safety Boiler Works, of Philadelphia, Pa. The device differs from the well-known lime-soda process softener, in that the chemicals are added to the water only after it has been heated to 205 deg. F. or higher, which results in a considerable reduction in the time required for the sedimentation, so that the apparatus can usually be installed within power-plant buildings and without requiring special foundations or housing. The feed-water heater is a part of the apparatus, thus reducing the complication and the expense of piping. It is also claimed that there is no after-precipitation of scale and sludge in pumps, piping, feedwater heaters, and boilers and that the minimum amount of sludge-forming solids enters the boiler and the tendency to priming and foaming is consequently minimized.

Uehling Instrument Co., 71 Broadway, New York, N. Y., combustion chemists, will exhibit fuel-saving devices at the Chemical Industries Exposition, Grand Central Palace on Sept. 20-26, and at the National Association of Stationary Engineers convention to be held at Milwaukee, Wis., Sept. 13 to 17, next.

TRADE CATALOGS

Flanged and Screened Fittings.—The Reading Valve Fittings Co., Reading, Pa., has issued a catalog of steel and iron flanged and screwed fittings and flanges.

Crushers.—The Kennedy-Van Saun Manufacturing and Engineering Corporation, 120 Broadway, New York City, illustrate and describe the Kennedy Gearless Crusher in a ten-page bulletin, No. 2. The advantages of this construction are greater speed and capacity resulting from rope or belt drive, reversible concaves because set vertically, improved material and design of construction, relatively low power consumption, and minimum abrasion of the stone-breaking parts. Garfield & Co., Hearst Building, San Francisco, are the Western general agents.

Separators. — The Griscom-Russell Co., 90 West St., New York City, is manufacturing a line of oil and steam separators of ingenious design which is described in the company's illustrated bulletins Nos. 1,120 and 1,140. The Stratton Junior Oil Separator (Bulletin 1,120) separating oil from oil-charged steam, has a special modification for use when pressures are below one atmosphere. The standard Stratton steam separator (Bulletin 1,140) removes water from the steam centrifugally, also, and stands guard between steam pulsation, flying water, sand, and scale, and the engine or turbine. Illustrations and tables in both bulletins aid in selecting the device suited for the particular need.

Dewaterer.—H. R. Wahl & Co., milling and mining machinery, First National Bank Building, Chicago, is building a simple machine for dewatering granular solids, which is fully illustrated and described in the company's bulletin D-1. The machine operates without scraping action, does not create slimes, lifts and drains the solids without contamination at any point, and permits close regulation of the water discharged with the solids. Three models are built, to meet varying conditions of size of material, tonnage per hour, dilution of feed, and limiting size of particle escaping with overflow.

Air Compressors—The Pennsylvania Pump & Compressor Co., Easton, Pa., has issued Bulletin No. 100, "Pennsylvania Air Compressors," which describes the company's Class A, power driven, single-stage, straight-line air compressors. Attention is called to a new type of ring plate valve, and an oil float gage for determining at all times the level of oil in the crank basin. The compressors embody, in addition to the above, a number of improved features of design, such as the use of a solid forged crank-shaft, forged connecting rod with solid box eyes, and removable bronze shell main bearings.